COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

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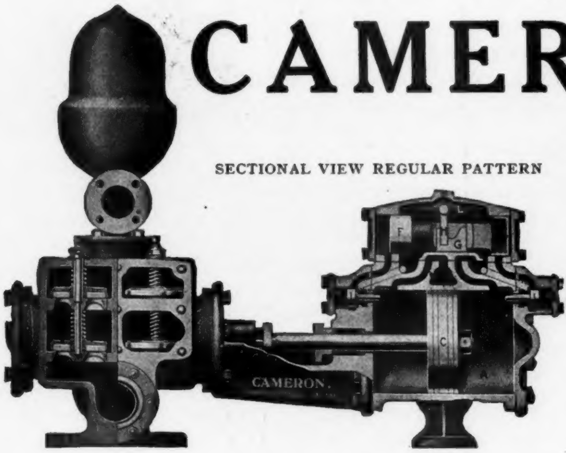
Classified Buyers' Guide, Page 12. Index to Advertisers, Page 8.

The Slogan of the Cameron—"Character: The Grandest Thing."

The working parts of a

CAMERON

SECTIONAL VIEW REGULAR PATTERN



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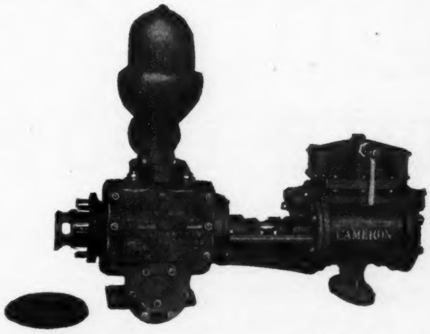

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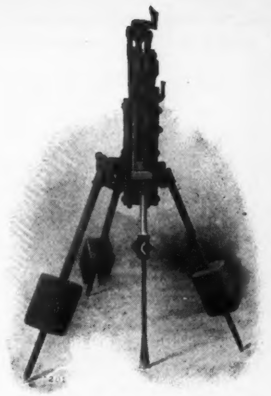

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There are several items of rock drilling cost, any one of which, if neglected or overlooked, may run the cost of drilling higher than it should be.

The labor cost per shift is just as high for a poor drill as for the best. **But because the best drill drills faster, it has the lowest labor cost per foot of hole.**

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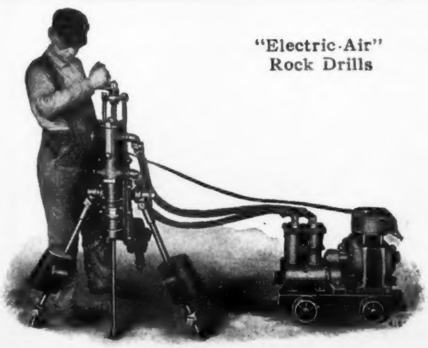

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INDEX TO ADVERTISERS.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XV MARCH, 1910 No. 3

COMPRESSED AIR FOR VENTILATION AND SAFETY IN MINES

At the Spokane meeting of the American Institute of Mining Engineers, in the discussion of the excellent paper by Mr. D. W. Brunton, on "Modern Progress in Mining and Metallurgy in the Western United States," Mr. W. L. Saunders spoke upon mine ventilation, saying, in part:

The importance of this subject can scarcely be over-estimated. It should surely be the province of the mining engineer not only to excavate material and treat it properly and economically, but in doing this he should study how to protect and conserve the lives of the miners. John Mitchell's figures show that four times as many men are killed in mines in the United States, in proportion to the number of men employed, as in any other country in the world. Explosions are responsible for much of this, but where explosions occur human life may be saved, provided there is a complete system of ventilation in the mine, and provided certain safeguards are employed. For instance, it has been urged by Mr. Mitchell that the introduction of compressed-air pipe-lines into all the workings of a mine might provide fresh air and even food to men imprisoned after explosions or through falls. This does not involve much expense, as mines are usually equipped with compressed-air apparatus, and the piping leading into the mine is of such a nature as to withstand considerable damage from the exterior. Furthermore, this piping at certain places, as, for instance, in the shaft, might be still further protected. Telephone wires inserted within the air-pipe might also serve a useful purpose in saving life.

Under Section VI., Underground Tramming, Mr. Brunton refers to the air and electric locomotives which have come into general use, and he makes the statement, which no one can dispute, that each has its own field. Following this, however, the claim is made that "where the openings are dry and the roof sufficiently high and firm to carry the trolley-wire insulators, there is no question as to the desirability of using electricity." This seems to be a rather slender hook on which to hang the interests of the compressed-air locomotive. The members of this Institute recently visited the Anaconda smelters where we saw air-locomotives doing useful service throughout the works. The superintendent when asked why he used air in preference to electricity answered, because it was better and cheaper. This is only one notable instance where air is preferred for traction purposes. There are many others, as, for instance, the Homestake, the largest and richest single gold-mine in the world, where air-locomotives do useful service not only in the yards but in the mines themselves. These installations, Anaconda and Homestake, are of the old type; that is, the simple compressed-air locomotive. Notwithstanding this, the results are satisfactory and economical. There is a new type of locomotive, built by the H. K. Porter Co., of Pittsburg, which should be able to add 50 per cent. to the saving in air-economy. This new type uses the natural heat of the mine as a reheater to expand the air between the high and the low pressure cylinders. Under the old system of simple compressed-air locomotive it was frequently true that the fuel required to furnish the power for the air and the electric systems was almost exactly the same. With the new system it is claimed that under the same conditions the fuel-requirements in air will be but two-thirds of that made necessary in an

electrical installation. There are some conditions where the electrical installation might prove more economical even than the compound compressed-air locomotive. Much depends upon the load-factor. With a good load-factor of from 30 to 40 per cent. of the rated power of the engines and generators furnishing the current, and with mining conditions which permit operating locomotives at rated speed and power, it should be possible with electric locomotives to obtain efficiencies approximating those found in connection with the operation of large street-railways; but in ordinary mining conditions there is much starting and stopping, tracks are crooked and curves frequent, and the ordinarily very poor load-factor results in an efficiency in mines even below that of the simple compressed-air locomotive.

Trolley-wires in mines are always more or less a source of danger, annoyance, and expense. This is especially true in gold, silver, and copper-mines, where many of the levels are operated simultaneously, and where the output per level is comparatively small. In such cases it frequently requires the services of several men and large quantities of copper-wire and insulators to keep the haulage-locomotives in close touch with the various working-places. Even in cases where the openings are dry and the roof high and firm, the trolley-wire becomes a menace when there is a wreck on the road or any other accident resulting in a short circuit.

Wherever the wires are carried near ore-chutes, or places which require occasional or frequent blasting, they are in danger of being ruptured or put out of service. Furthermore, the danger from the fire cannot be over-estimated, inflammable material being frequently in proximity to the wires.

The long entry to the mine can obviously best be equipped electrically, but in the various ramifications of the mine compressed air has been proved to be safest and best.

The argument that the air-locomotive loses time in charging has some merit, but observation of the performance of the electric locomotive in mines proves that the time lost in handling the trolley-pole under ordinary mining-conditions is approximately as great as that due to charging the air-locomotive. In narrow drifts it is sometimes found impossible to turn the trolley-pole, and the locomotive has to be run a considerable distance with the trolley-pole in advance of, instead of trailing behind, the support. Under such conditions very slow speed and great caution are required in order not to break the poles or tear down the wiring. Ordinarily charging a compressed-air locomotive means the loss of about a minute and a half for every 4,000 ft. of travel.

ROCK DRILLS.

It is to be regretted that Mr. Brunton dwelt so briefly upon the subject "Rock-Drills," for surely this valuable adjunct to the miner deserves serious consideration. The rock-drill has made the mining and smelting of low-grade ores profitable. Development-work, tunnel-construction, drifting and stoping are all pursued to-day to a greater extent than in olden times, because the rock-drill has been perfected to that stage of simplicity where it may be used profitably and economically. It is difficult to find in the list of mechanical appliances a machine which has been subject to greater wear and tear or in the building of which experience is of more importance, than the rock-drill. The design of a rock-drill is not by any means everything to be considered in looking for the best. Material and workmanship are of the greatest importance, and the skill which can only come of experience when applied in the construction of this important mining-tool should surely be of value to the miner who is seeking a reliable machine for permanent use.

AN UNUSUAL TUNNEL EXPLOSION

The work of constructing the new aqueduct for the Catskill water supply for New York City is being pushed rapidly, the various contracts employing in the aggregate a great number of men, and it has hitherto been highly gratifying to note the infrequency of serious accidents as the work has progressed, but an explosion which occurred in the heading of the McKeel tunnel near Cold Spring on January 21, helps to make up the fatal average. This explosion, it would seem, must remain unexplained. The report of the engineers of the Board of Water Supply gives all the facts with clearness and frankness, but leaves much to individual opinion as to the details of the occurrence.

It is explained that the usual practice included a heading round of 22 holes; 6 for the center cut, these being from 8 to 9 feet

deep and the others 7½ to 8 feet. The rock was so tough and hard to break that it was necessary to fire the cut several times before blasting the side rounds, the firing being done by battery outside the tunnel. There were only 15 men in the tunnel and 10 were killed, including the foreman. The five who were saved were some distance back from the heading, and got to the outside without assistance, but were so seriously affected by the concussion and the gas that they could give no coherent account of the occurrence.

At 2.30 p. m. the first shot on the 6 center cut holes of the heading were fired, at 2.50 p. m. the second shot was fired and some 10 minutes later the men re-entered to load for the third shot. At 3 p. m. a much heavier explosion than usual attracted the attention of the men outside, and soon afterward the survivors were seen crawling from the entrance. Attempt was made to enter the tunnel to rescue the other men, but the gases and smoke prevented any such rescue work for a full hour. When finally the heading could be reached, eight of the bodies were found on the main bench just over the heading bench and two bodies, including that of the foreman, on the heading bench near the cut. None of the bodies were greatly mutilated, as they would have been by a heavy fall of rock, and death had been caused by concussion, not by asphyxiation.

There were no indications of an extensive explosion. The four upper holes of the six holes for the center cut were loaded preparatory to the third blast, but investigation failed to show that the lower two of these six holes had been loaded, although they were covered with the muck from the explosion.

Two explanations have been offered: The first is that the rock had become so heated from the two successive blasts as to have set off the powder as it was being loaded for the third blast. This is discredited. In the first place the dead foreman was known as a most careful man who certainly would have determined the heat of the holes before loading them. Then, the four upper holes of the cut still contain the load for the prospective third shot; had the explosion been in the heading these shots must certainly have been burned, thrown out or exploded. Finally, after each regular blast it was possible to clear the tunnel in 10 or 15 minutes, but the fatal explosion so fouled the air that it was an hour before entrance could be had. This would indicate that the explosion took place in the open bore and not from heating or by the accidental discharge of a previous misfire.

The other explanation is that the dynamite resting on the bench for use in loading the holes, probably a 50-lb. box, and perhaps more, was exploded by some shock, such as the falling of a small stone on a cartridge with exploder attached. This theory is borne out by the condition of the heading, which is not shattered as it would have been by an explosion in the holes, by the location and condition of the bodies and the evidence, noted above, that the explosion was in the open.

CATS IN FORMALDEHYDE

At the coal mines of the Northwestern Improvement Company at Red Lodge, Montana, the Drager rescue apparatus has been tested with satisfactory results, and is now being permanently installed. One of the tests is thus reported:

There was a two-hour test of endurance at the test house at the mine today and the men came out of a room that had been charged with formaldehyde in good spirits and as fresh as if they had been travelling over the bench land in the invigorating air of this community. They experienced no inconvenience whatever, except the heat of the hermetically sealed room. Their breathing was as natural as if they had been walking on the soil, and after going into the fresh air they did not have any unusual feeling in or about their natural breathing apparatus.

On a couple of the tests cats were taken into the room. The first, upon entering, jumped up into the cage and scratched as if trying to get out. Then it sniffed and sneezed and scratched its nose with its paw, then it executed a few devilish whirls and settled down peacefully to die, while froth covered its mouth and its eyes grew dim. When it was about to bid farewell to its tormentors it was taken outside, where, in due time, it recovered. The next cat showed signs of wanting to die very soon after it had been introduced to the formaldehyde.

A NEW HYDRAULIC ROCK DRILL

A new hydraulic rock drill has made its appearance, the invention of Mr. Warlaw Wolski, an Austrian engineer, and one of the best known figures in the petroleum industry of Galicia. As the practical success of the drill cannot as yet be considered as demonstrated it is of interest to our readers chiefly as a proposed competitor of the air driven drill. A study of the drill in detail shows that after all it is by no means independent of the air. The following description we take, with some condensation and omission, from *The Engineer,* London.

Certain very real disadvantages have militated against the adoption of hydraulic power for rock drills up to the present time. The difficulty of constructing a powerful hydraulic motor lies in the nature of the force-transmitting medium, which is heavy and almost incompressible. Every stoppage and every change in direction of the motion of the water is necessarily accompanied by a more or less heavy shock of the water in the pipes and the motor, and this phenomenon, increasing in force with the rapidity of the motion, limits the speed of working in a very definite manner. It being impossible to overcome the difficulty of the hydraulic shock, Mr. Wolski has utilized it, and, in fact, in forms the basis of the action of his apparatus.

Reference to the diagrammatic sketch of the apparatus given in Fig. 1 will render the mode of action clear. The drill consists essentially of a cylinder, in which is a piston C free to move, while at the other end of the cylinder is a flap valve D, which is kept open by a spring. The interior of the cylinder is in communication with a "striking tube" F G, at the end F of which is an air vessel. When the valve H is opened, water flows through the apparatus, out past the valve D, into the waste pipe E. The rush of water past the valves causes the pressure on the under side to be less than the pressure on the upper side, where the velocity is less. This, of course, is in accordance with the well-known law of hydraulics, the pressure being least where the velocity is greatest. The two are, in fact, connected by the relation—

$$\frac{v^2}{2g} + \frac{P}{w} = \text{constant},$$

v being the velocity of the water in feet per second, P the pressure in pounds per square foot, g the acceleration of gravity, w the weight of a cubic foot of water.

In the present instance differences of level can be neglected. When the velocity attains a certain value the difference of pressure is sufficient to close the valve, and the column of water in the striking tube is suddenly stopped. The kinetic energy of the water in the tube is communicated to the piston C, which is impelled forward with high velocity, and the drill which is at the end of it strikes a heavy blow on the stone or rock being bored.

The pressure in the interior of the cylinder is diminished by the moving out of the piston C, and at the same time the water, having been compressed by the shock, acts like a spring, and surges back into the air vessel. The extent of the surging is of course very small, on account of the small compressibility of water—about 48-millionths of its volume for each atmosphere—but the combined effect of these two is to cause the pressure in the cylinder to fall low enough for the valve to open. Water then streams through the open valve. The piston is meanwhile being brought back to its original position by springs, but before it is right back, and while it still has an appreciable velocity to the left, the valve D closes, and the direction of motion is reversed by the hydraulic shock. The drill then strikes another blow as before. The actual apparatus is shown in section and plan in Fig. 2, which is roughly to scale, the overall length being about 4 ft.

It will be noticed that the boring bar is rifled. The female part of the rifling arrangement is provided with a spring device, whereby the rifling is only engaged on the return stroke. The drill thus strikes a direct blow with a rotary return. The boring bar passes at its right hand end through a guide which is packed with a leather packing. It is easily replaced when worn. The whole drill can be dismantled in five minutes for inspection. The drill is bolted to a drill post, which may be either held between roof and floor in the ordinary way, or supported on a carriage, or, for small power drills working soft rock, may be supported on a tripod.

The actual magnitude of the blow depends primarily upon (1) the weight of the striking column; (2) the velocity of the water when the valve closes; and (3) the weight of the chisel and boring bar.

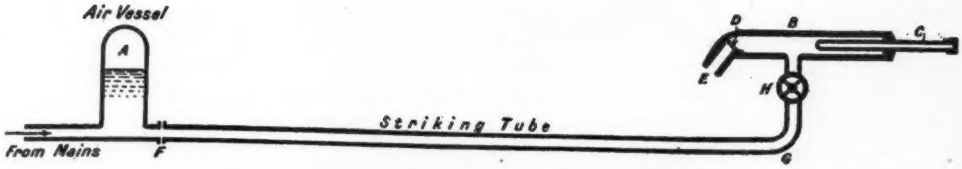


Fig. 1

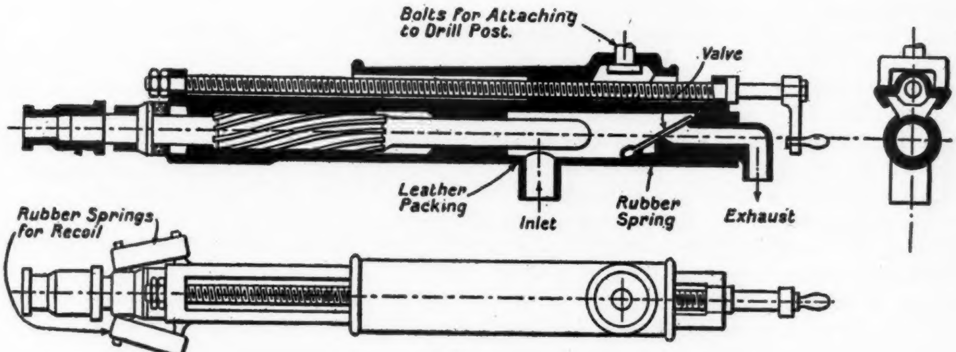


Fig. 2

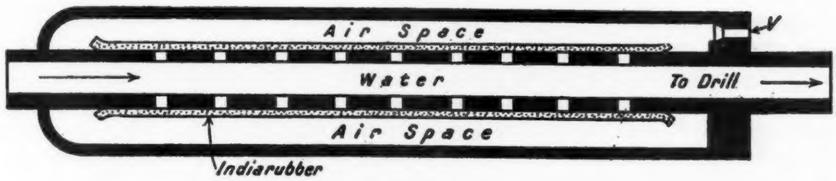


Fig. 3

A NEW HYDRAULIC ROCK DRILL.

Since the kinetic energy of the striking column is

$$\frac{1}{2} \times \frac{w}{g} v^2 \text{ foot-pounds}$$

where w is the weight of the column, v the velocity at the instant the valve closes, in feet per second, $g = 32$ ft. per second, it follows that the magnitude of the blow will be proportional to the weight of the striking column and to the square of the velocity of the column. The weight of the chisel and boring bar affects the problem in so far that a certain relation between the weight of the striking column and that of the chisel and boring bar, is necessary in order to ensure the most efficient transmission of the energy of the striking column to the chisel and boring bar. As a matter of fact the best effect is obtained when the mass of the striking column is equal to the combined mass of the chisel and boring bar.

The velocity of the column is fixed by the velocity at the valve required to produce the necessary difference of pressure to close the valve, *i. e.,* it is fixed by the stiffness of the spring controlling the valve. The rapidity of the blows is limited by the fact that after each blow the striking column is brought to rest, and it must be accelerated up to the requisite velocity before the valve will close. The rapidity of working depends, therefore, upon the pressure which is urging the column forward, *i. e.,* it depends on the pressure in the supply mains. The actual magnitude of the blow is said to be unaffected by the varying pressure in the mains, and to depend only on the weight of the striking column and the strength of the spring controlling the valve. The inventor claims that machines of the type described strike from 20 to 30 blows per second, while the maximum speed of percussion machines of existing types is from 3 to 5 strokes per second.

One of the Wolski machines has recently undergone a series of tests at the Millbank Pumping Station of the London Hydraulic Power Company. The pressure used was 450 lbs. per square inch. This, with a particular type used, would give a pressure in the interior of the apparatus of 3000 lb. per square inch. The tests were carried out on a block of hard Portland stone. The diameter of the drill used was 2 3-8 in., and on an average progress was made in the stone at the rate of 10½-in. per minute. This is equivalent to the removal of 46 cubic inches of stone per minute. The drills stood up to the work so well that after holes aggregating about 25 ft. in depth had been drilled, it was not necessary to do anything to the edge. A stream of water plays on the chisel the whole time, and serves the three-fold purpose of keeping the chisel cool, of rinsing the bore-hole, and of allaying the dust.

The machines can, we understand, be made to work at any pressure from 5 atmospheres (75 lb. per square inch) upwards. For the softer rocks, such as coal, the lower pressures may be used with advantage, but for the harder rocks where a larger striking tube and heavier drill bits are used, the higher pressures are recommended, the increase of effect with the higher pressures being very marked. If the striking tube is arranged to be straight and nearly to coincide in direction with that of motion of the chisel, there is, it is explained, very little shock on the machine, since the force of the shock is transmitted directly to the chisel, and the machine merely serves as a casing and guide for both masses. There is, however, no absolute necessity for the striking tube to be straight, if the conditions do not admit of it easily.

The consumption of water for all purposes in a machine of the above type is from 3 to 4 cubic feet per minute. The weight of the apparatus upon which the tests were made is about 100 lb. This is the weight of the machine itself, exclusive of the stretcher bar, striking tube and air vessel. The drill may easily be manipulated by two men, and, if necessary, can be controlled by one. During the tests at Millbank one man only, we are informed, was employed on the drill.

The air vessel used is not the type shown in the general arrangement sketch, which is only diagrammatic, but is of the special and ingenious design shown in Fig. 3. The wall of the inner tube is perforated by a large number of small holes like a sieve. Over this is stretched an india-rubber tube, fastened by tying up at both ends. The whole is covered by a steel tube, closed hermetically at both ends, and the space between this tube and the inner one is filled with air, forced in through the valve V by means of a pump. During the boring work the hydraulic pressure and the air pressure act against one another, and the india-rubber, now expanding, now contracting, forms the elastic separation between the air space and the water space.

POSSIBLE ECONOMIES IN ICE MANUFACTURE

Some twenty-five years ago, when a mere boy, the writer was projected, much against his will, into the ice machine business. A complete stock of general ignorance in this especial line enabled him to stumble through one or two jobs successfully, and as time wore on the beauties of the situation unfolded. Being a chap of ordinary brightness, he absorbed and compressed into his storage tank some very interesting experiences, and was soon thoroughly familiar with the situation as it then was.

Having an inquiring mind, he naturally bored into many abstruse questions, the leading one of which was "Why do we burn coal to make ice, as it seems like a paradox?"

To-day he is still unable to give a logical answer, as his mental excursions into the realms of thermo-dynamics failed to reveal one. Theoretically, we should gain heat instead of losing it. However, we passed it up, and now ask another question or two, viz.: Why are we content to burn 400 lbs. to 500 lbs. of coal to make a ton of ice when it can be very comfortably done on 200 lbs. by steam power, and 100 lbs. if the gas-producer is used with gas engines?

Question No. 2. "Why has the development of the artificial ice machine remained nearly stationary during this long time?" In 1880 the battle raged between the compression and absorption systems and the relative merits of the wet and dry compression. To-day it is still raging on the same points, with practically little advantage on either side and neither doing much better than at first. Some improvements have been made from time to time, but the results remain practically the same. In

support of this statement, I call attention to a page advertisement in a recent issue of a trade journal, which advertises that a builder of distilling apparatus has taken a certain modern plant, which was turning out 2.89 tons of ice to the ton of coal, and improved it so that it now makes 3.60 tons to the ton of coal. Good for the apparatus! but isn't this a rather humiliating state of affairs when a ratio of 1 to 10 should be easy of attainment? This is not an isolated case. The majority of small plants do not turn out more than four tons of ice to one of coal, and it is tight work to make the plants pay. Like the rheumatic old gentleman who feels the coming storm before it breaks, does not the operator of the small plant feel something which indicates a disturbance in the atmosphere of the ice business—sort of a heavy humidity which oppresses him? F. A. Rider in *Ice and Cold Storage Journal.*

COMPRESSED AIR BATHS

At the Brampton (London) Hospital for Consumption and Diseases of the Chest a compressed air treatment is in use and, on newspaper report, with gratifying success. A large round air chamber is provided with a compressor for supplying the air. There is a door for entrance, and several port holes closed with plate glass. There is also an air lock for occasional use. There is within a table and three or four chairs, that number of patients being treated at a time. The normal atmospheric pressure is only raised about one-third of an atmosphere, or from 30 to 40 inches of mercury.

When the patients have entered the pressure is augmented so gradually that it takes half an hour before the full pressure is reached, which is manitained for an hour, and then half an hour is taken for the return to the normal. Reading or quiet games pass the time; a sign within reads: "Talking strictly forbidden." The necessity for this is thus explained by Dr. Wood, the physician in charge:

"You see, the effect of the compressed air, apart from its curative action, is rather curious. It has, if anything, a rather exhilarating action, and gives rise to that happy feeling said to be experienced by those who climb high mountains. Now, you can quite see that, in any case, it might be bad for patients, perhaps rather weak, to start a conversation which might possibly develop into a hot argument."

"It is impossible," Dr. Wood continues, "to explain the exact effect of the treatment. It is certainly beneficial in many cases of bronchitis or asthma, but whether that is caused by the increased amount of oxygen in the bath or whether the pressure expands the cells of the lungs or air passages I hardly feel qualified to say. Some time is taken, anyway, before the good effects are felt, and a complete course means some twenty baths, taken at intervals of three times a week."

HIGHER PRESSURES FOR GAS SERVICE

During the past year several gas companies in this country, including those at Boston, Chicago, Milwaukee and Detroit, have experimented with high-pressure gas lighting, with encouraging results, especially when employing burners made for, and properly adapted to, high pressure. In Europe, notable progress has been made in this direction, particularly in Berlin, where, on July 1st of this year, 25 miles of streets were being lighted with 1,531 high pressure gas lamps, supplied by four separate compressors, with gas at from 53 to 78 inches of water pressure, and giving light, in some cases, of over 4,000 candle-power each. It was stated last April that Berlin had decided to spend 7,000,000 marks, at the rate of 1,000,000 marks (about $250,000) per annum, in installing in all thoroughfares incandescent inverted gas burners under pressure; and that this decision had been arrived at after much investigating and experimenting by competent officials. Fleet street, London, and some parts of its adjacent streets, and also some fine bridges in that city, are being very successfully and brilliantly lighted in this way, and further extensions of the system are being made and contemplated. Other cities in Germany outside of Berlin, and others in England outside of London, are also beginning to adopt this system of street lighting. In Fleet street the cost is said to be one penny per hour per 1,500 candle-power of light. In Berlin the consumption for a given quantity of illumination is said to be one-quarter that of the former low-pressure lamps used, and the lighting is said to be very much cheaper than electric lighting, even with the latest type of electric burners.

THE DUST PROBLEM OF THE SAND BLAST

A valuable series of papers by Dilien Underhill is appearing in current issues of The Foundry, and from the latest we abstract the following dealing with important features of sand blast apparatus and its profitable manipulation.

The cleaning of castings for enameled ware is accomplished largely by the use of the sand blast. By this means a perfectly clean casting can be obtained, and no dust, which is injurious to the enamel, is left on the metal. If any of the sand blast is left on the casting it will melt and form a part of the glass, which is a constituent of the enamel. The most serious problem in sand-blasting is the removal of the dust. The air in the room where the sand-blasting takes place is saturated with a fine powder from the broken particles of sand, and if not properly taken care of will penetrate adjoining buildings, rendering them uncomfortable and unhealthful.

EXHAUSTING THE DUST INTO WATER.

Naturally, one would think that exhausting into or under water would solve the problem. This, however, is not the case. When the dust is exhausted into tanks, it forms into little globules, and these rise to the surface, open up, and the dust nuisance is still the same as before. Of course, some dust settles to the bottom; but sufficient rises to the top to make the system ineffective. In one instance, the dust was exhausted into a river and it was believed that the volume of water would be large enough to moisten the particles, but this proved as unsatisfactory as the water tank, and it was soon abandoned.

THE DRY EXHAUST SYSTEM.

Two general systems of dust elmination have been developed, both of which have proved successful. The dry system of exhausting through cloth is being installed by a prominent manufacturer, in many enameled iron plants. Briefly, an exhaust fan carries the dust and air into an enlarged chamber where its velocity is spent in attaining a larger volume. The dust strikes the cloth but does not pass through it, while the air seeps out with hardly any perceptible current. The sand drops down into a receptacle and is removed.

THE STEAM EXHAUST SYSTEM.

The second system, while probably not quite as clean as the dry method, has the advantage of being inexpensive both in installation and maintenance, as it can be built by a carpenter and a plumber in a short time. It takes care of all the dust by exhausting steam into a large wooden chamber into which the sand blast dust also is exhausted. At A, Figs. 1, 2, and 3, is shown such an arrangement. For the two sand blast rooms, a tower, built of rough boards, set on end, is provided. It is about 20 feet high, 5 feet in diameter at the bottom and 3 feet at the top. Exhaust steam discharges into the top of the tower. The dust from the sand blast rooms enters lower down and has a tendency to rise. The steam condenses, mixes with the sand, and both are precipitated. If the door is left open, the wet sand will fall out to be carted away or, it can be carried out on a belt conveyor.

THE SAND BLAST ROOM.

The sand blast room is usually about 10 feet square and 10 feet high. The walls should be lined for a short distance with metal to resist the wear of the striking sand. Fresh air should enter from the roof or along the sides near the roof, from several openings, to prevent a draft on the workman. The exhaust should be from the bottom, as shown, to accommodate two rooms. With this arrangement, the workman has an ample supply of fresh air and this minimizes, as much as possible, the rising of the fine dust. In any case, a helmet and gloves must be worn to protect the skin from the sand. This method does away with an aspirator if the proper exhaust fan is used, and the room is occasionally allowed to clear itself of dust entirely. In some plants, two men work in each room. They alternately relieve each other in carrying the castings to and from the room and sand-blasting them.

In exhausting the sand, baffles are introduced to deflect the larger particles into the pit. Only the finest dust then goes up into the fan. The coarser grains flow into the pit and are carried up in an elevator to a storage tank or box to be used over again,

as shown in Fig. 3. This sand can also be taken care of in a hopper underneath the floor as indicated by the lines XX, Fig. 2.

In this case a grating would be used and no sand would have to be shoveled. It is not desirable to pass the sand so direct as this to the sand blast machine, as a rotary riddle should be installed under the elevator spout to take out scrap, gates, and runners, which would otherwise clog the machine. A very small particle will close the slot in the sand blast machine.

slightly inside the sand blast room. The sand can then be shoveled into the top of the machine through an ordinary sieve. With the system shown, a rotary riddle should be placed under the elevator spout. The sand blast installations of a number of sanitary ware foundries are similar to that shown in Fig. 4.

It is quite simple in operation. The sand is placed in the upper sand hopper, the air is cut off and the sand inlet valve drops down as shown in Fig. 4. The sand then falls

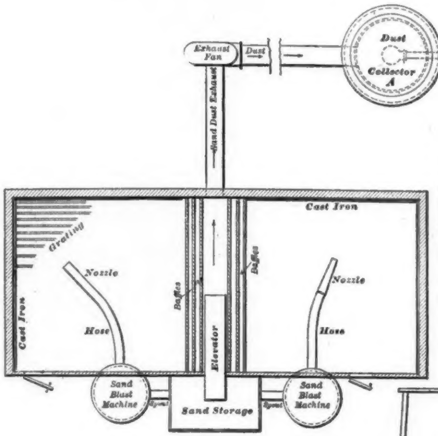


Fig. 1

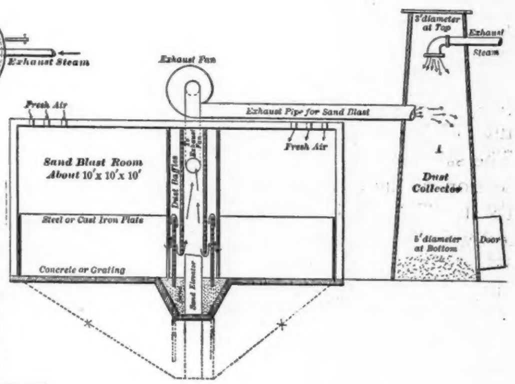


Fig. 2

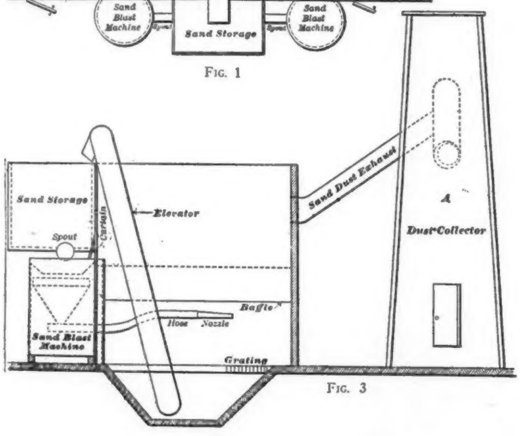


Fig. 3

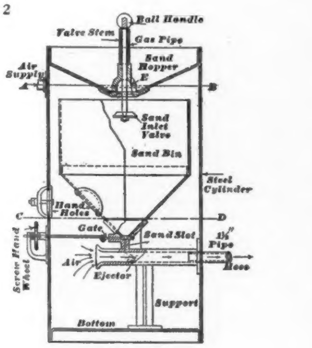


Fig. 4

SAND BLAST ARRANGEMENTS.

New sand must be thoroughly dried before it is placed in the machine hopper. The description in detail in the article quoted of arrangements for sand drying it is not necessary to reproduce here.

THE SAND BLAST MACHINES.

The sand blast machine is shown in Fig. 1. When the grating is not used, it is convenient to have the edge of the cylinder set

through the inlet *E* and drops down into the lower sand bin. When this is full the inlet valve is raised against its seat by pulling up the ball handle. This is held in position until the compressed air is let into the tank, and when the full pressure of air is on, it is held firmly in place. The air then passes out through the ejector and into the hose. The hand wheel is next given a few turns and this pulls out the sand gate, allow-

ing the sand to fall down into the ejector. The sand and air are proportioned by the hand wheel and a lever is sometimes used instead of the wheel, with a set screw as a gage for the sand gate opening. The current of air, under 20 to 30 pounds pressure, carries the falling sand along in a continuous stream and projects it against the casting. The air flows out with a steady pressure, assuming that the supply is kept up, and the outside cylinder, being closed top and bottom, serves as an air reservoir. The machine is built of 3-16 inch steel plates, and the cylinder is 30 inches in diameter and 4 feet 6 inches high for this capacity.

The sand hopper is usually a casting, or a plate and a casting as shown, the latter being preferred as it is more easily machined. The sand bin rests on top of the conical projection of the ejector and is riveted or bolted to it. This is its only support. It is set away from the outside shell 1½ or 2 inches. Hand holes are provided in the shell and also in the sand bin so that the slot, which chokes up if the sand is not dried and screened properly, can easily be cleaned.

The sand bin man-hole is an ordinary curved plate, held in position by the air pressure. The shell manhole must be held in place with a gasket and bolt as shown, or the air will leak out. Air leakage is expensive and difficult to detect, and for that reason all joints should be carefully tested.

Man-holes are frequently provided in the upper sand hopper as well as in the bottom, to facilitate cleaning out. Sand blasts are often built without the support shown. If it is not cast integral with the ejector, it should be braced separately instead of hung from the side alone.

The Soo Canal opened to commerce a little over 100,000 tons in 1855 with a depth of 11½ ft. on its mitre-sills, when there was a scant 8 ft. of water on the St. Clair flats. Successive enlargements of the locks and deepening of the restricted Lake channels now give an available depth of about 20 ft. In 1907, 58,217,214 tons of freight were carried through the locks of the Soo. The freight was slightly over 20 per cent. of our railroad ton-mileage. The cost of service fell from 1.5 mills in 1888 to 0.69 in 1908, 9 per cent. of railroad rates.

AIR COMPRESSOR CYLINDER RATIOS

The following we condense from a paper by Mr. Snowden B. Redfield in a recent issue of the *American Machinist*.

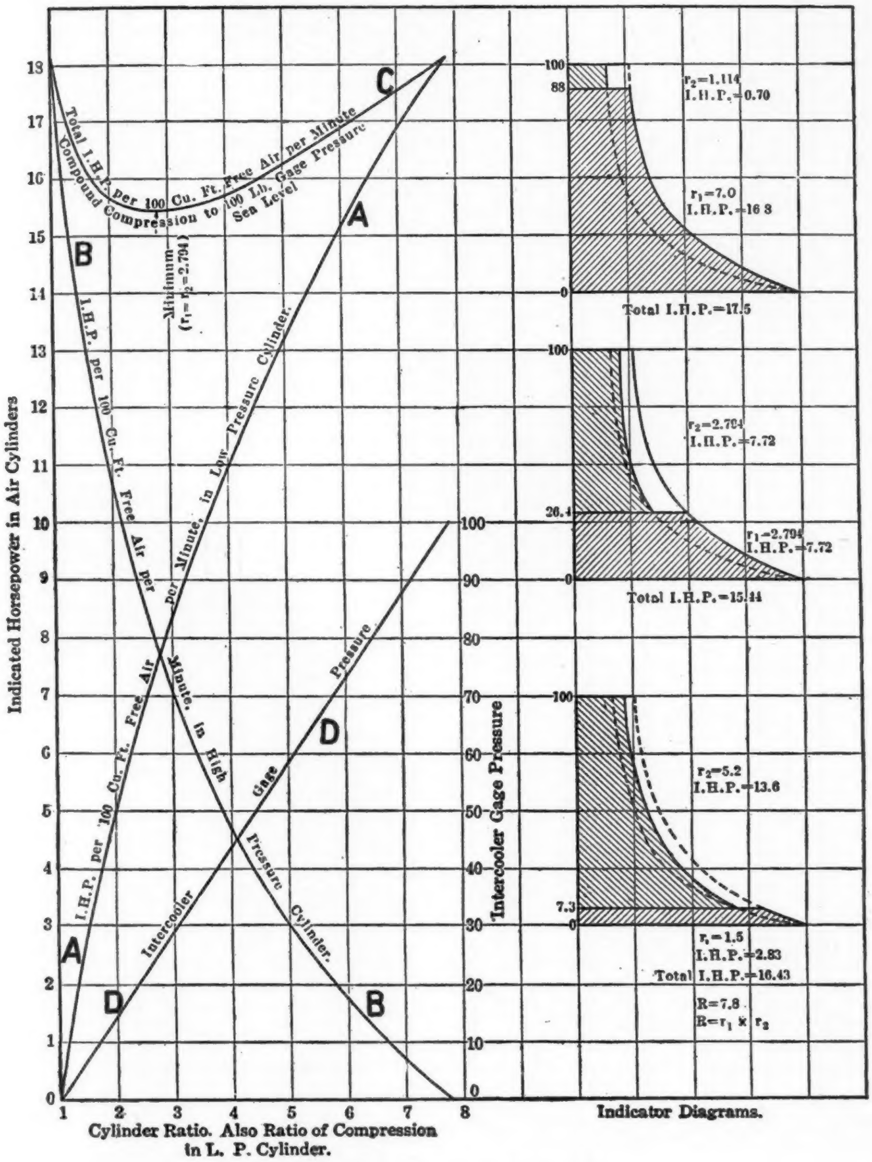
Power saving by stage compression in an air compressor is due solely to the cooling of the air between the stages, and without the intercooling the work could be done slightly more cheaply in the single cylinder.

On the right of the accompanying cut are three theoretical indicator diagrams of a compound air compressor working from atmosphere to 100 pounds gage with different cylinder ratios, the actual compression being assumed to be adiabatic in each case. In the middle diagram the assumed cylinder ratio is 2.792, the square root of the total compression ratio, which is $114.7 \div 14.7 = 7.8$. With the ratios here assumed the work of the two cylinders is equal, and the total power required for the compression will be the minimum.

In this diagram compression in the first cylinder is carried up along the adiabatic line from atmosphere pressure to that of the intercooler, which is 26.3, gage. This is obtained by multiplying the atmospheric pressure, 14.7 pounds absolute by the cylinder ratio and subtracting 14.7, like this: $14.7 \times 2.792 = 41.04$ and $41.04 - 14.7 = 26.3$. All the air entering the low pressure cylinder must go into the high pressure cylinder after cooling to the original temperature, and at equal temperatures the absolute pressures are inversely proportional to the volumes. This reduction in the volume of the air by the intercooling is where the saving of power occurs in compound compression.

Compression in the high-pressure cylinder follows up the adiabatic line as shown, until it eventually meets the 100-pounds pressure line, when the air is discharged from the cylinder. The shaded area below the 26.4 pounds pressure line represents the work done in the low-pressure cylinder, and the shaded area above this line represents the work done in the high pressure cylinder. Under the imposed conditions these two areas will be equal. That portion of the diagram which is unshaded represents the amount of work which is saved by compounding over and above what would have to be done if the compression were in a single stage.

In the diagram below the one we have been considering the cylinder ratio is made 1½, or



AIR COMPRESSOR CYLINDER RATIOS.

the low pressure cylinder has only 1½ times the volume of the high pressure cylinder and the intercooler pressure is only 7.3 pounds gage. The temperature of the air as it leaves the low pressure cylinder is not as high as in the previous case and consequently there is less reduction of temperature and volume in passing through the intercooler, and less possible saving of power as the result of the intercooling.

In the upper indicator diagram an extreme of ratio in the other direction is noted, the cylinder ratio here being 7 to 1 and the intercooler pressure 88 pounds gage. The shaded area above this pressure line represents the work done in the high pressure cylinder,

which is very small compared with that done in the low pressure cylinder.

As shown by these three diagrams, the horse power in each of the two cylinders varies with the cylinder ratio and the total horse power, or the sum of two, varies also. At the left side of the cut before us are given several curves having to do with the entire range of cylinder ratios, and consequent ratios of compression, from 1 to 7.8, the units of these ratios reading on the lower horizontal line. The curves *A* and *B* show the horsepower of the low pressure and of the high pressure cylinders respectively. Starting at the left on line *A* the horse power in the low pressure cylinder increases from 0 with a cylinder ratio of unity to a maximum of 18.1 with a cylinder ratio of 7.8, the latter being the highest possible ratio when compressing to 100 pounds. With a cylinder ratio of unity, or with both cylinders of the same capacity, all the work of compression would be done in the second or high pressure cylinder, this amounting to 18.1 and dropping off, according to the curve until with a cylinder ratio of 7.8 it finally reaches 0.

Rerferring now the upper curve, *C*, "total indicated horse power per hundred cubic feet of free air per minute," etc., it will be found that the minimum total horse power occurs, for 100 pounds final pressure, when the cylinder ratio is 2.794, the ratio of compression in both cylinders being the same, the actual horse power also being the same in both cylinders 7.72 and the total horse power of course 15.44 per hundred cubic feet per minute compressed to 100 pounds gage.

For three stage compression the cylinder ratios would be the cube root of the total ratio of compression, and for four stages the ratios of the contiguous cylinders would be the fourth root of the total ratio.

In ordinary working perfect intercooling is never obtained, the effect of which is to slightly raise the intercooler pressure and the intake pressure of the high pressure cylinder above that of theoretical conditions. This of course throws back more work upon the low pressure cylinder, and to obviate this it is considered good practice to make the actual cylinder ratio a little less than the theoretical ratio.

The clocks of Paris, operated by the Popp pneumatic system, were stopped for three weeks by the flood.

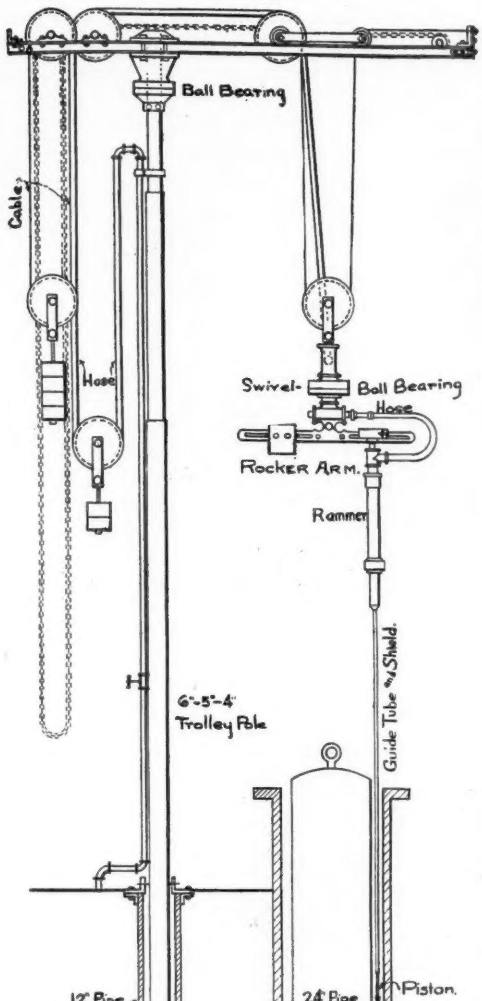
A BALANCED UNIVERSAL PNEUMATIC SAND RAMMER

The cut shows the essential principles of design and construction, and suggests the almost unlimited possibilities of application, of a pneumatic foundry rammer made by the Henderson Engineering and Sales Company, Madison Avenue, New York. Its special line of employment is in the ramming of deep vertical models as for cylinders, pipes, ingot molds, etc. As will be seen the weight of the rammer is always balanced, and it can be moved in all directions not only horizontally but also vertically the balancing of the weight and the ball bearings provided where rotation occurs making all the movements easy for the operator.

The efficiency of the sand rammer has heretofore been seriously limited by the fact that the kick or rebound of the machine has rendered physically impossible the accurate direction of the blows. A most important accomplishment of this machine is the absorbing of the kick or shock of the pneumatic rammer to insure against the displacement of the tool by its own action and permitting the constantly accurate placing of the blows.

The shock absorber is an arm centrally suspended from a pivot on which it vertically rocks. On one end of the arm the pneumatic hammer hangs on a pin permitting it to swing freely horizontally on the line of the arm. On the other end of the arm is rigidly attached a counterweight somewhat lighter than the rammer. The shock or kick of the rammer passes into the rocker arm, which driven upward by the blow is caught by the counterweight, held suspended in the air, and prevented from rebounding against the pneumatic rammer and disturbing the rammer from its position. The rammer, after striking the rocker arm upward drops its weight on the rocker arm and is saved from disturbance from its position by the counterweight arm giving way before it in the same manner as on its upward movement.

The machine as shown in the cut is employed in ramming a deep circular mold as for a water or gas pipe or for a column. A wrought iron trolley pole is provided for the mast of a jib crane. The crane jib, riding on ball bearings, is of I beams which serve as a track for a movable carriage on which are sheaves for the suspension cable and air hose. The suspen-



BALANCED PNEUMATIC SAND RAMMFR.

sion cable is tied on the forward end of the jib, passes over a sheave on the forward end of the jib carriage, then down under a riding sheave which supports the air swivel, the shock absorber and the rammer. From the riding sheave the cable passes up over a sheave on the rear end of the jib carriage, then over a sheave on the rear extension of the jib and down under a riding sheave from which is suspended the main counterweight, and then is tied to the rear extension end of the jib. The air hose connecting with the air pipe line at the side of the pole and passing over the jib and the jib carriage sheaves to the air swivel is kept straight by a light counterweight on another riding sheave.

The jib carriage is quickly and easily moved in or out to center over different sizes of molds, by means of an endless chain hanging within the operators reach by the side of the pole, and the freely swinging jib permits the operator to move the rammer practically without effort from one ramming seat to another.

The rammer is provided with an extension piston, or rammer stave, of wrought pipe of suitable size. Attached to the barrel of the rammer is a guide tube inside of which the rammer stave operates. The operator swings the balanced rammer around the circular mold, controlling it by a guide tube which passes upward through his hand as the ramming of the mold progresses. The vertical movement of the rocker arm permits the operator to follow easily any irregularities on the surface of the mold which may occur from the uneven feeding of the sand.

For ramming car wheels or other work that must be rammed where it is to be poured and which cannot be reached by a jib crane, the machine is suspended from a carriage riding on an I beam or other overhead track and moved at will through the shop. To a main supporting carriage thus traveling on an overhead track, is rigidly attached an air swivel which carries a swinging arm. From one end of this non-rocking arm is suspended the riding sheave supporting an air swivel, a shock absorbing rocker arm and a pneumatic rammer. The opposite end of the arm supports the counterweight in the same manner as did the jib of the crane.

The details of applications of this apparatus to different varieties of work will readily suggest themselves without further description.

When the steamer Phyllis recently arrived at the Panama canal zone, her cargo is said to have received even more respectful attention than that of the steamer that shortly before arrived at Colon loaded with congressmen. The Phyllis had aboard 1,032,000 pounds of dynamite.—*Contractor.*

A SPECIAL RAILROAD DITCHER

The accompanying illustrations, adapted from *Engineering News,* will give us a tolerably clear idea of a railroad ditching machine designed by Mr. Ben. Bowman, Springfield, Mo., built for the Southern Pacific Railway ana used by it upon its lines in California and elsewhere. The entire apparatus is built upon a flat car, and when in use is towed along the track by a locomotive. As it has to do with the ditches upon both sides of the track, every ing back out of the way for the operations in which they are not used. The illustrations show the cranes in different positions. The function of the cranes is to raise and dump the scoops and to assist in guiding the plow and sloper. The air cylinders for the hoists are in the center of the car between the cranes. For each crane there is a large cylinder to operate the main hoist and a smaller one for the auxiliary hoist used in dumping the scoops. The compressed air is supplied by three air

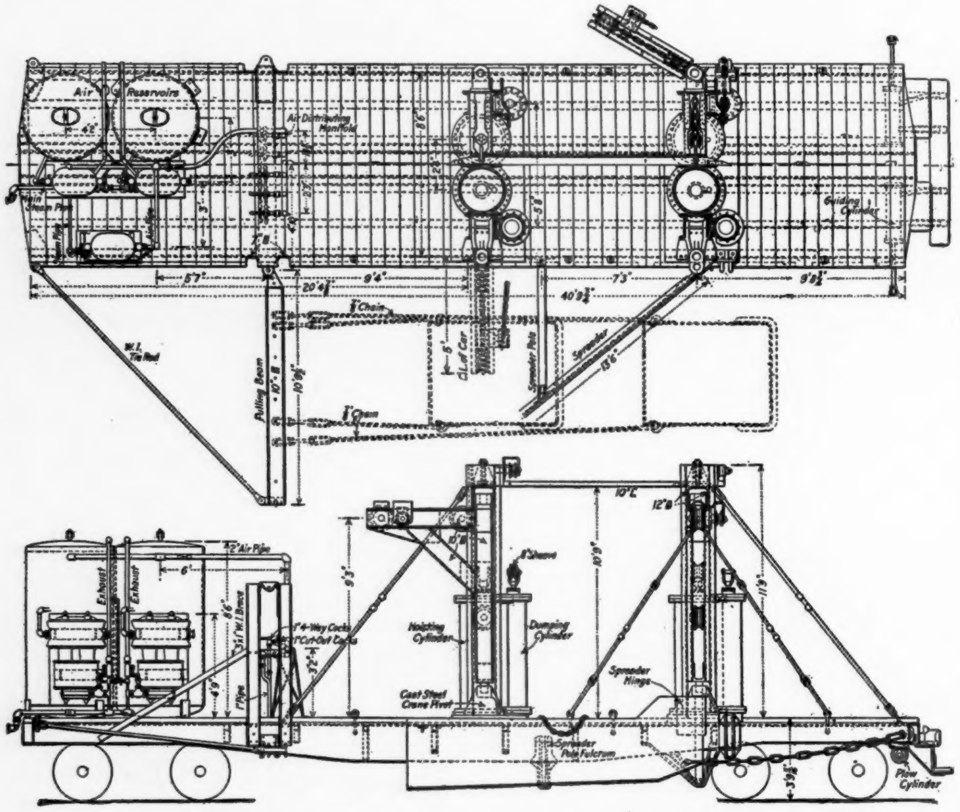


FIG. 1. PLAN AND ELEVATION OF RAILROAD DITCHER.

operative detail upon either side of the car is installed in reverse upon the other side. The machine either makes new ditches entirely or operates upon existing ditches to widen or clean them, as may be required.

THE PNEUMATIC CRANES.

There are two pneumatic cranes upon each side of the car, these cranes standing out at right angles to the car when in use and swing- brake pumps which, together with the two vertical air receivers, are mounted on the forward part of the car. Steam for the pumps is taken by a hose from the attendant locomotive. The operation of the various hoists is controlled by one man at the air distributing manifold. Besides the eight hoisting cylinders there are also two horizontal plow-guiding cylinders under the rear end of the car.

THE PLOW.

The plow is shown in operation in Fig. 3. It is hung from the main chain of the rear crane, which controls its working depth, and its line of action is controlled by the guiding cylinder acting through a steel pole attached at the rear of the plow-beam. A second steel pole projects from a fixed bracket on the side of the car and is attached to the plow-beam near its forward end. This pole has a universal joint at the bracket so that it can follow any vertical or horizontal movement of the plow. A pulling cable passes from the forward end of the plow-beam to its fastening on the forward corner of the car.

The pole projecting from the bracket on the car body acts as a distance rod or strut to hold the plow to its course against the lateral component of the pull in the cable. The outer end of the pole serves as the fulcrum about which the plow turns under the action of the guiding pole. A considerable range of working dis-distance from the track is attainable with one length of pole by varying the length of the pulling cable, but the pole is made in two parts, one telescoping within the other so that its effective length may be changed to permit a wider range of working distances.

THE SCOOPS.

The material loosened by the plows is collected by the scoops as shown in Fig. 4. There are two scoops for each side of the car, one being handled by each of the four cranes, and each scoop has a capacity of 4 cu. yds. They are so hung that when lifted, after having been drawn through the loose material and loaded, they will tilt backward, and this tilting is restricted by chains connecting the bale of each scoop to its back wall. The loaded scoops are hoisted by the main crane cylinders through a single chain attached to the bale. The dumping chain, fastened to the back of the scoop, is operated by the smaller auxiliary hoist.

The scoops are dragged through the material loosened by the plow by chains leading to the pulling beam. There are two chains for each scoop, attached one on each side at the front near the bottom. The pulling beam is shown in the half tones and in the plan, Fig. 1. The chains are coupled to the beam by vertical pins passed through holes in the channels and through the coupling link between. The beam extends out about 10¾ ft. from the side of the car body and is provided with a number of coupler holes so that the scoop chains can be attached at any point as desired in working at different distances from the track.

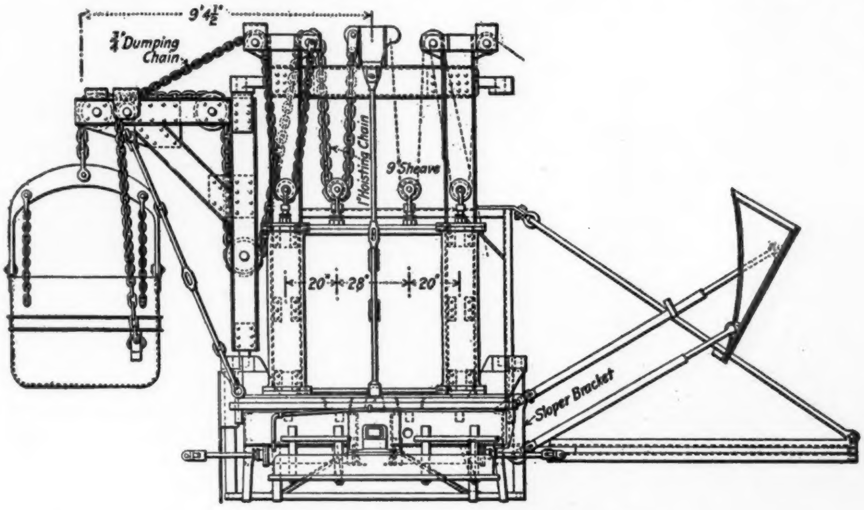


FIG. 2. FRONT END ELEVATION OF DITCHER.

The beam has a pin joint, or hinge, at its junction with the car body and the tensional component of the pulling strain is taken by a diagonal tie rod from the outer end of the beam to the forward corner of the car. When not in use, the tie rod is disconnected and the

beam is swung in forward against the car body. A second tie rod passes from the end of the beam to the top of the rectangular frame above the manifold and supports the beam's weight.

THE SLOPER.

The sloper is pulled by this same beam and

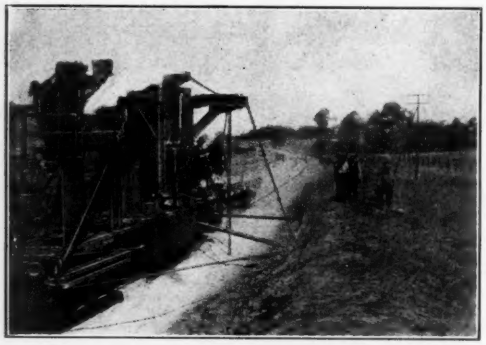


FIG. 3. PLOWING HARD EARTH.

is attached to it by a cable and leading chain, as shown in Fig. 5. It consists simply of a flat laminated steel plate about 4 ft. square to which is riveted a curved plate flaring away from it at the rear to act like the mold board of a plow. No guiding pole is used with the sloper, but there are two fulcrum poles universally jointed to their bracket on the car body and attached to the sloper, as shown in the end elevation, Fig. 2. By changing the relative lengths of these poles, it is possible to change the angle of the bank the sloper cuts.

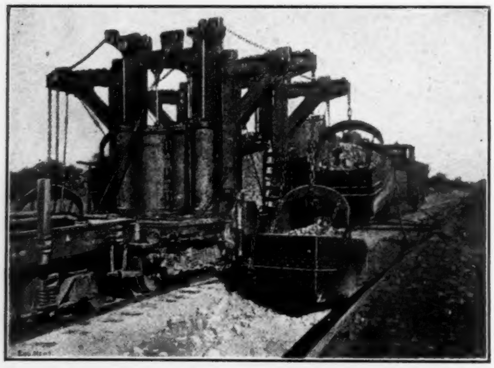


FIG 4. THE SCOOPS AFTER THE PLOW.

As shown in Fig. 5, the working position of the sloper is controlled by the main chain of the rear crane, from which it is hung.

THE SPREADER.

The spreader is shown in Fig. 1 (plan) in its working position, swung out to an agle of about 40° with the direction of motion. It is held in this position by a bracing pole extending out from the frame of the car. When not in use, the pole is removed and the spreader can be swung back on its hinge until flat against the car body. The spreader is used in distributing dumped material to give an even surface to fills alongside the track.

In using the ditcher, the first operation is to break up the ground with the plow. Then the scoops are put in position and pulled through the loose material by means of the locomotive. The filled scoops are lifted by the pneumatic cranes and the locomotive tows the ditcher to the dumping place. When necessary, the dumped material is leveled off by the spreader. The ditcher is then returned to the cut and the final slope of bank is obtained with the sloper. The scoops may again be necessary.

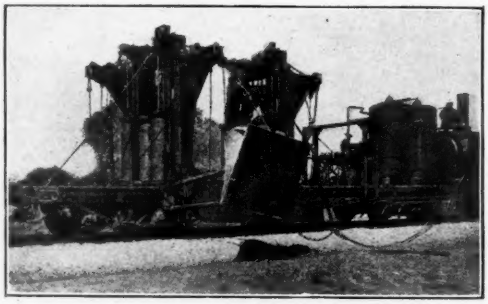


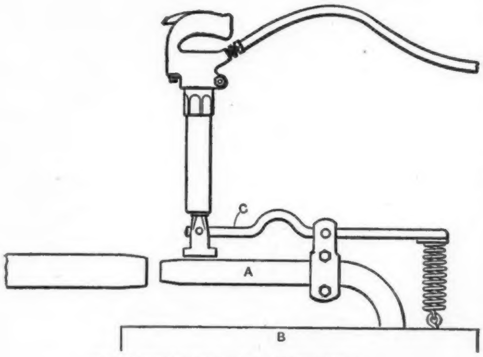
FIG. 5. SLOPER READY FOR USE.

During the preliminary tests of the ditcher it was tried out on the material of the California foot hills in midsummer when the soil was baked to nearly the consistency of hardpan. Under these conditions, and when the operations of plowing, sloping, hauling and spreading were all required, a total of 360 cu. yds. was removed in six hours. This was done in 30 loads, with an average travel of 1,200 ft. from cut to dump.

FLUE WELDING WITH A PNEUMATIC HAMMER

An inexpensive flue-welding device that was designed to handle a large repair job that came in unexpectedly is shown in the accompanying illustration. It consists of a mandrel *A,* which is attached to a cast iron block *B,* and a pneu-

matic hammer (equipped with a swage), which is mounted on a lever *C*. As the illustration shows, this arm is fulcrumed to a bracket on the mandrel and is spring supported. The ends of the long pieces were first scarfed by lowering the back end of the tube until it was about six inches below the level of the mandrel. This gave a taper of approximately ¼ inch to the inch. After all the long pieces were scarfed, short pieces about 8 inches long were placed in the furnace and heated on one



FLUE WELDING ARRANGEMENT.

end so that they could be drawn to a feather edge. This also was done under the pneumatic hammer. After all the flues were scarfed and the short ends made ready for welding, the horse upon which the outer ends of the flues had rested, was raised to bring the work level with the mandrel. All short pieces were then put on the flues while hot so they would shrink tightly in place, thus insuring a good clean weld by preventing any dirt from getting between the surfaces to be welded. After all flues were treated in this way the furnace was cleaned, and the welding done at a speed which would make many of the costly flue-welding machines hustle to keep up with.—*Machinery.*

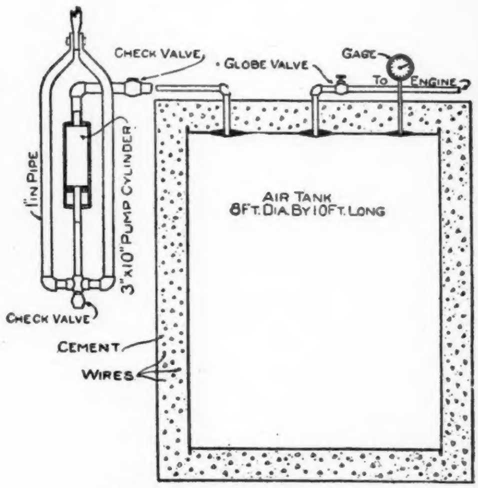
A WINDMILL AIR COMPRESSOR

C. L. Perrin, Kerhoven, Minnesota, tells in Popular Mechanics how he worked out a practical and cheaply operated compressed air service for his little shop. He says:

There are some tools in nearly every blacksmith shop, no matter how small, that require a steady power of some kind or other to run. I had a small steam engine for a while, but soon found that I did not use it enough to pay me to keep up steam.

I then built myself a windmill, thinking that it would be cheaper than a gas engine, but the power it gave would not run the tools at a steady speed. The sketch shows how I finally won out and used both my windmill and steam engine.

I made an air pump which worked similar to an ordinary bicycle pump. Having a 3 by 10-in. pump cylinder on hand I made a piston for it, using a 1-in. gas pipe for a rod and a leather washer held between two flanges on one end of the rod for a plunger head. On the other end of the rod I screwed a 4-way pipe coupling and into this a nipple and vertical check valve as shown in the sketch. I then connected two upright pipes to the side openings of the 4-way coupling by means of elbows and nipples. The nipples I filled with lead to make them air-tight. The upright pipes are bent to-



WINDMILL AIR COMPRESSOR.

gether at the top and flattened so as to make a connection for the pump rod of the windmill. On the top end of the cylinder is attached a pipe, with a check valve in it, and connected to a large air tank which I had a tinner make of heavy galvanized sheet iron. The tank is 8 ft. in diameter and 10 ft. long and is reinforced with concrete and heavy wire. A pipe line with a globe valve in it connects the tank to the engine. A gauge is also attached to register the air pressure. The pipes are fastened to the tank with heavy flanges.

The windmill which I made myself has a 16-ft. wheel and develops power enough to put 80 lb. air pressure in the tank and that pressure easily runs my 3-hp. steam engine. The tank fills about as fast as I use the air, thus I am able to run my engine for several hours at a time with practically no cost at all. The engine is well packed so as to utilize all the air with as little waste as possible.

Number of tools		1	5	10	15	20	25	30	35	40	45	50
	Diameter Stroke.											
Chipping Hammers.	1 1/8"x1"	14 2.6	69 13	134 25	197 37	258 48	315 59	370 69	421 79	470 88	517 96	560 104
	1 1/8"x2"	17 3.2	18 16	163 30	240 45	313 58	383 71	449 84	512 95	571 106	627 117	680 127
	1 1/8"x3"	20 3.7	98 18	192 36	282 52	368 69	450 84	528 98	602 112	672 125	738 137	800 149
	1 1/8"x4"	22 4.1	108 20	211 39	310 58	405 75	495 92	581 108	662 123	739 138	812 151	880 164
	1 1/8"x5"	25 4.7	123 23	240 45	353 66	460 86	560 105	660 123	753 140	840 156	923 172	1000 186
Riveters.	1 3/16"x6"	33 6.1	162 30	317 59	465 87	607 113	743 138	875 162	993 185	1109 206	1218 227	1320 246
	1 3/16"x8"	36 6.7	176 33	346 64	508 95	662 123	810 151	950 177	1084 202	1210 225	1328 247	1440 268
	1 3/16"x9"	38 7.1	186 35	365 68	536 100	699 130	855 159	1003 187	1144 213	1277 238	1402 261	1520 283

Large figures are free air and small figures are horsepower to drive compressor. Figures for air are for 80 pounds pressure at sea level, and are based on ordinary intermittent service as is usual in any shop. Ratings for one hammer are actual readings from water displacement tests, being averages of many trials. Horsepower figures assume compound air compression to 85 pounds pressure and include friction. For single stage compression to 85 pounds add 15 per cent to power figures. Compressor displacement required should include volumetric loss as figures are for actual air delivered.

TABLE OF PNEUMATIC HAMMER AIR CONSUMPTION.

AIR AND POWER REQIREMENTS OF PNEUMATIC HAMMERS

It is to be regretted that, through a mistaken policy in the beginning, many of the manufacturers of pneumatic tools have heretofore resorted to the publication of what are really "nominal ratings" for the cubic feet of air required to drive their machines. This condition of affairs is similar to that in the automobile business, where a tendency to overrate the engine power in many cases is well known. The excuse for such procedure is that the other fellow does it, and consequently if any manufacturer has the backbone to give the real figures, his machines will not compare so favorably on paper with those of his competitor.

Some measure of excuse may be granted when it is said that most of the figures given for air required to drive pneumatic tools are based upon calculation and estimation only, as the actual measurement of the air required to drive any machine is a little difficult to accomplish without special apparatus. As a matter of fact pneumatic tools of different makes do not vary a great deal in their air consumption for a given amount of work done, and so, for estimation purposes for the installation of a suitable compressor, the figures given in the accompanying table are of timely interest.

In this table are given the actual cubic feet of free air required per minute and the power to operate from one to fifty pneumatic hammers of the cylinder diameters and strokes shown. The quantities of free air for one tool have been obtained by careful experimenters with special water-displacement apparatus, and being the averages of a great many readings, may be taken as accurate and fairly representative for most tools of similar dimensions. The figures for more than one tool were obtained by deducting 2 per cent. for every five tools; that is, five chipping hammers are assumed to require 4.8 times as much air as one chipping hammer of equal size. Ten hammers are assumed to require 9.6 times as much as one hammer, and so on. This is to

allow for the intermittent action of different tools in a shop, and this basis of calculation agrees very nicely with observed shop practice.

The quantities of air, as shown by the larger figures in the table, are actual cubic feet of free air required at atmospheric pressure at sea level, this air being delivered to the tool at 80 pounds pressure. The figures for horsepower, which are the smaller figures in the table, assume compound compression to 85 pounds pressure; that is, allowing 5 pounds drop in the pipe line. The figures for power also include reasonable friction of the compressor and the usual losses of power in the air cylinder of an air compressor of reasonably good design. They would represent just about the brake horsepower required from an electric motor to drive a compressor actually delivering the quantity of air given by the large figures above them.

This brings up the point of the volumetric efficiency of the compressor. As the quantities shown were obtained by actual measurement of air used, it is imperative that the output of the compressor shall be equal to this. To allow for volumetric efficiency loss, this necessitates that the piston displacement of the compressor shall be greater than these figures by from 8 to 12 per cent., depending upon its design. The figures for power required include this loss, as they represent the power necessary to actually deliver the quantities of air shown as the actual output of the compressor.

In cases where single-stage compression is used the power required may be obtained by adding about 15 per cent. to the power figures given. This, of course, has no effect upon the air quantity.

It has been stated that these figures are for sea-level operation. This will be satisfactory for most localities, but at 5,000 feet elevation 17 per cent. more free air capacity will be required and about 7 per cent. more horsepower, for the same size and number of tools. These increases are practically proportional to the altitude.—*S. B. R., in American Machinist.*

Be thankful every morning when you get up that you have something to do that day which must be done whether you like or not.—*Kingsley.*

A TRANSCONTINENTAL TUNNEL

The tunnel up in the Andes which is to connect the Argentine and the Chilian railways is now approaching completion, and next year trains may run across South America from the Atlantic to the Pacific. The tunnel is comparatively short, being little more than two miles, but the undertaking has been a difficult one, not only from the nature of the rock, but because the work was so far from civilization, and especially on account of the altitude, 10,000 feet above sea level, or more than twice the height of Ben Nevis. It may easily be imagined by those who have climbed in the Alps how much physical discomfort has had to be endured by the engineers and their men. We may well believe that without the air compressor, the rock drill and the pneumatic locomotive the task would never have been accomplished.

It is twenty-two years since work was begun at Mendoza on the Argentine side of the great enterprise of crossing the Andes. Step by step the lines have been carried further and further up the mountain valleys from both sides, but even now the traveller has to spend a day on mule-back and in a coach in crossing the pass from the Argentine to the Chilian rail-head—a toilsome though attractive trip that is not possible in winter. When the tunnel is open for traffic the day's weary journey will be reduced to an hour in a comfortable railway carriage, and Valparaiso should be brought within two days of Buenos Ayres. Travellers will gain much by the improvement, and communication between the neighbor republics will be as easy as it has been difficult hitherto. The tide of immigration may be expected no longer to stop in the Argentine, but to flow on to Chile, now that the long and often stormy passage round the Horn may be avoided. It is possible, too, that the Chilians may develop a large export trade overland through Buenos Ayres. The wealth of their country has not yet been properly exploited, because with all their energy the Chilians are geographically on the wrong side of South America. But with the continuation of the splendid Argentine railway system into Chile a great awakening should come for that vigorous little Republic.

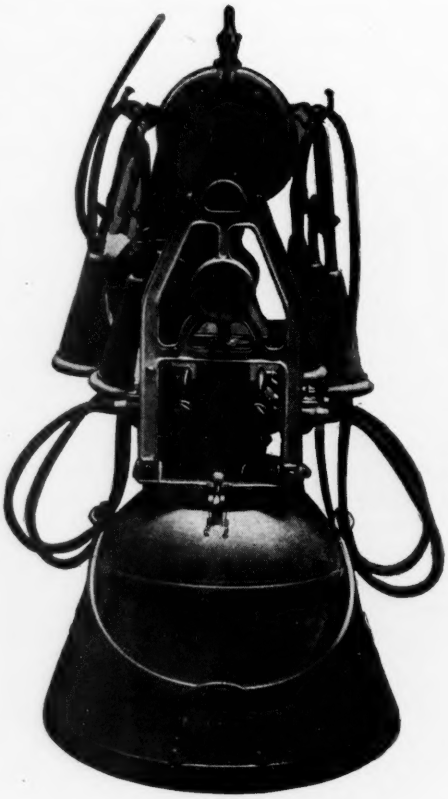
NAPOLEON AND THE VACUUM PROCESS OF FOOD PRESERVATION

It is not generally known that Napoleon Bonaparte was the first promoter of the modern process of canning foods. Records of the French Academy of Science lately brought to light in Paris tell the story.

The French nation was strenuously voicing its disgust at the manner in which the "Little Corporal's" soldiers were compelled to carry their food and to eat it on the march, and Napoleon directed the Academy to offer a prize of 12,000 francs to the man who could keep foods indefinitely in their natural preservations.

Nicholas Appert won the 12,000 francs. He discovered what has since been perfected into the present-day method of canning, for he simply inclosed the food in airtight containers and subjected the whole to such a degree of heat that the contents received a thorough sterlization. The vessels which Appert used were clumsy. He was handicapped in his efforts by poor utensils. However, he originated the fundamental principle which is used in American canneries today. Now, however, in place of Appert's crude vessels, fruits, vegetables and the like are placed in bright, new, clean cans, which are made airtight. The second division of the process is the subjection of the cans to intense heat. Boiling water at a temperature of 212 degrees Fahrenheit is the natural sterilizer in which thousands upon thousands of cans are allowed to stand for a given length of time. If cooked by steam or in a retort at from 240 to 260 degrees or more, the product is not given as long a period of sterlization. Science, since Appert's day, has determined the length of time necessary. The operation is simple yet the process is all-important. Nothing more than the heat treatment is necessary to keep the delicacies in a pure state for years.

The heating of the can and contents for sterlization is taken advantage of to secure the perfect exclusion of the air. The can being filled as full as possible with the material to be preserved the little space remaining is occupied by steam, and the sealing of the can while hot, by soldering or otherwise, and the subsequent condensation of the steam within leaves a practically perfect vacuum. The process is so entirely successful that there is no necessity to-day for the chemical preservatives formerly used, and there is no longer any incentive for the introduction of foreign substances.



AN ELECTRO-PNEUMATIC MILKING MACHINE

The accompanying half tones show us the Liberty Cow Milker, manufactured by the Liberty Cow Milker Company, Hammond, Ind. The actual status of this so called "electric" machine is quite similar to that of the Electric Air rock drill, in that it provides a new field of employment for the electric motor to give life to the aparatus, while the ultimate operation is essentially and exclusively pneu matic.

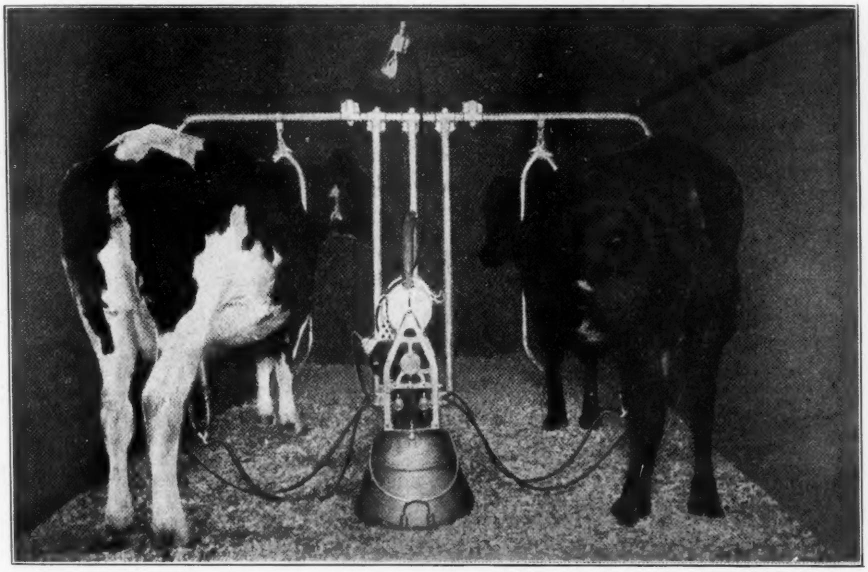
The milker consists of two essential parts: the milk can or receptacle and the milking machine proper. The cans are made alike and are duplicated so that the machine can be removed from one to another. The base of the machine forms the cover for the can, fitting

upon it and making an air tight joint with a rubber gasket. There is a little motor geared to a crank-shaft and two vacuum pumps which run constantly when the machine is in use and maintain a vacuum in the can. The amount of vacuum in the can is indicated by a gage at the side and this vacuum can be regulated by a needle valve, the pumps normally giving somewhat more vacuum than is required.

Essential parts of the apparatus are a pair of double valves operated by a reducing motion from the crank shaft, which work intermittently at regular intervals. Each double valve is equipped with a stopcock and a rubber tube of sufficient length and a transparent and flexible connection with shut-off clippers to a pair of teat cups carrying pneumatic cushions. The valve is so constructed that in one position a hollow cylinder connects the can vacuum with the teat cup, and in the second position it breaks the vacuum and opens to the atmosphere. After this operation is completed suction is again applied and milk is drawn, the cycle of operation being continuously repeated. This intermittent use of the vacuum and its release imitates the sucking of the calf and its intermittent taking of breath and swallowing of the milk.

TO KNOW WHEN THE COW IS MILKED.

Beneath each teat cup is a small glass tube, where can be seen the flow of milk, and a small shut-off clip. This clip will collapse the tubing and thereby shut off the vacuum, so that when there is no milk flowing from the teat, the clip can be closed and the teat cup taken off so that the test will not be kept under vacuum longer than is necessary. It has been noticed that a calf as well as a hand milker milks the right and the left sections of the udder alternately, and a cow will give down her milk more freely if milked thus alternately than if the milk is drawn from all four teats at once. It is known that often in one section of the udder there is a larger accumulation of milk than in the other. This machine is so constructed that when suction is applied to, say, the right hand teats and their milk is being drawn, the two left hand teats are released so that milk may be accumulating in them. At the next operation milk is drawn from the two left hand teats and so on, milk being never drawn from all four teats at the same time.



MACHINE MILKING TWO COWS.

As will be seen from the half tone, the machine milks two cows at once, and one man can look after five machines. It is said that within a very short time the cows become accustomed to the machine, and as this process is more after the process of nature, the cows feel more comfortable and seem to enjoy this way better than hand milking. The milk, it will be noticed, passes from the cow into the

can without exposure to the atmosphere, which is coming to be recognized as a necessary sanitary precaution. The machine can of course be operated in a barn or shed or in the yard, wherever the wires can be led to it.

A NEW SMOKE CONSUMER

A device for consuming smoke, or rather for preventing the production of smoke, is being marketed in Great Britain. The device is practically an extra grate composed of perforated asbestos and fireclay blocks. This is built behind the ordinary grate, and is proportioned so as to give an intense temperature to the air required for perfect combustion. The smoke and unconsumed gases passing from the fire-grate are retarded by the extra grate, and igniting give flame instead of passing into the boiler flues as a mixture of smoke and unconsumed gases. No holes and no steam jets are made in the boiler. The apparatus works automatically, and can be turned on or off by moving a lever below the door of the furnace. The effectiveness of the system was demonstrated at a recent test in a Glasgow oil and paint mill. The fire was coaled with ordinary furnace fuel, and it was allowed to burn for a few minutes without the coal-consuming apparatus being in operation. Black smoke issued from the chimney in copious quantities. Then the apparatus was applied, and within forty seconds—the time required to allow the flues to clear—not the slightest semblance of smoke was to be seen at the mouth of the chimney.

A HIGHWAY TUNNEL THROUGH MISSIONARY RIDGE

A tunnel, 700 ft. long, in hard rock, now more than half completed, is being driven through Missionary Ridge, near Chattanooga, Tenn., which will save the traffic over the ridge, a long detour and a hard climb. The base has been driven about 400 feet from the west or lower portal, the tunnel having a grade of 5 per cent. thus affording natural drainage during the progress of the work. The rock is a hard blue limestone, in strata inclined about 45 degrees. The tunnel base is about 36 feet wide and 26 ft. high, and lined with masonry. The excavation is conducted by first removing a top heading 8 ft. high for an advance of 10 ft., then timbering with segmental timbering and finally removing the bench, no wall timbering being required. The drilling plant consists of a 70 horse power marine boiler located near the portal with a 12x16 in. Ingersoll Rand compressor operated at 110 lbs. gage pressure and four drills made by the same firm. A full account of the work with several interesting half tones is given in a recent issue of *The Contractor*.

ACETYLENE LAMPS FOR MINERS

Acetylene lamps consume about one-fifth as much oxygen as candles do to give the same amount of light. On that account, when it is necessary to work in badly ventilated stopes or headings, acetylene lamps should be used, not only because they consume less oxygen, but also because they give a bright light in air in which it is difficult to make a candle burn. Acetylene lamps are now made small enough to be worn on a miner's hat; they are used at the Saginaw mine on the Menominee range, Michigan. While the lamps require some attention in order to keep the water feeding properly to the carbide, the miners soon learn how to care for them. The lamps then give little trouble. It is said that it costs about two-thirds as much for light when acetylene lamps are used as against candles. At the Michigan mine the cost of the carbide required to last a 10-hour shift is about 2 cents.

GROWTH OF THE GAS ENGINE

In a bulletin of the United States Geological Survey recently issued it is said that the internal combustion engine has already become a serious rival of the steam engine in many of its applications, and that the development of the large gas engine especially has within the last few years been extremely rapid. Only nine years ago a 600 h. p. engine exhibited at the Paris Exposition was regarded as a wonder, but to-day four-cycle, twin-tandem, double-acting engines of 2,000 to 3,500 h. p. can be found in nearly all well-equipped steel plants, and some plants in this country contain several units rated at 5,400 h. p. each. More than 500 producer gas power plants, ranging in size from 15 to 6,000 h. p. are now in operation in the United States, about 88 per cent. of them running on anthracite coal.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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THE MAKING OF ROCK TUNNELING RECORDS

In the preceding issue of COMPRESSED AIR MAGAZINE we presented an abstract of an interesting paper, first published in the *Engineering Record,* giving an account of the work in the Rondout tunnel of the Catskill aqueduct system, and the recent making there of a remarkable time record on tunnel driving. As a contribution to the discussion of the means and methods by which rock tunneling records are being made, both in the United States and in Europe, we reprint the following letter to the editor of the *Engineering Record*:

Sir: The record of progress in tunnel driving made by the T. A. Gillespie Company on the Catskill Aqueduct, described so clearly in the *Engineering Record* of Jan. 1, is a valuable contribution to the archives of tunnel progress in America. We read a great many statements in the newspapers and in some scientific publications about remarkable tunnel progress, but when the cases are analyzed certain favorable conditions are discovered which account for the progress and which so far affect the case in comparison with other tunnels as to make the record valueless. The first point usually discovered is that the rock is not rock at all. I have in mind a recent widely published tunneling record where the progress was so extraordinary that I was induced to examine the case on the ground, and found that the holes in the headings were being bored by an auger and that much of the work was done by steam shovels.

The record made by the Gillespie Company in the Rondout pressure tunnel belongs to rock tunneling records, and in this respect it may be compared with the Simplon, Loetschberg and other well-known tunnels. Tunnel driving when progress is considered, is usually a matter of heading driving; that is, one naturally asks after reading a record, what is the diameter of the tunnel driven? This, of course, has some influence in driving a heading. A large diameter of tunnel, for instance, large enough to admit of the use of steam shovels for removing the muck, might materially aid the heading progress, because after tunnels reach diameters of 10 ft. and over the best practice is to drive a pilot heading, followed by a bench, and the more room one has from the bench line to

the portal the easier it should be to get rid of the material.

Tunnel headings are driven of such height and width as will best admit of the proper handling of the machinery. It would be a mistake, for instance, to drive a heading 5 ft. by 6 ft. where a tunnel of larger dimensions is wanted, because machinery cannot be used to advantage in so small a heading. It is, therefore, the usual practice to make the height of the heading only sufficient to clear the heads of the men or say 6½ to 7 ft. and the width from 9 to 12 ft. We may, therefore, place all rock headings where the dimensions of the completed tunnel are larger than the heading dimensions in one class when comparing progress.

The record made by the Gillespie Company, 488½ ft. in 30 days, representing a daily average of over 16 ft, closely approaches the remarkable records made in the Alpine tunnels, notably at Simplon and Loetschberg. It is generally admitted that Alpine tunnel progress has been unsurpassed anywhere in the world when a fair comparison is made of heading driving in solid rock. Alpine tunnel progress has reached 1 ft. per hour or 24 ft. per day, daily averages from month to month being from 18 to 20 ft.

In view of the fact that the same rock drills were used at Rondout as at Lotschberg, it would seem reasonable to say that the difference is due to the system employed, but as that difference is not great one would hardly advise Messrs. Gillespie to make any changes in the methods of work.

An important factor, which is a part of the system of Alpine tunnel driving, is that the rock is broken up fine and this, I think, accounts for the Rondout record, where I am very much inclined to believe, from the descriptions given, the rock is broken up fine and blown as far as possible away from the face of the heading. It is obvious that where the cut-holes and side-rounds simply break large chunks of rock which fall at the face considerable difficulty will be experienced in getting the drills at work, while with finer material and heavier blasts, which means a greater number of holes and more powder, access to the face of the heading may be accomplished in less time and the drills put promptly to work. While it is a common statement that the problem in tunnel progress is to get rid of the muck, it must not be forgotten that to get the drills at work quickly after the blast is of the greatest importance, because the quicker they get to work, and the better they work, the greater number of holes may be driven in the face, and the finer the material may be broken. This simplifies the problem of mucking.

W. L. Saunders.

COMPRESSED AIR, THE TIME AND COST SAVER

It is curious to note the course of the modern acceptance and the later spreading and accelerating adoption of compressed air as a means of power transmission and application. Its life-work may be said to have begun only half a century ago in driving rock drills for tunneling and mining. Here, of course, its use was, in a sense, compulsory, and its earlier friends and would-be promoters spent more time than it was wise to do in explaining and apologizing for the power losses involved in its use, inviting the assumption that, therefore, compressed air could never have much to do in other lines.

The air brake developed another extensive field of great usefulness, in which compressed air was most indispensable. Then the presence of a spare air-brake pump in every railroad shop, and the readiness with which a small supply of compressed air could thus be obtained led to the invention of many varieties of labour-saving devices, so that compressed air soon came to be in demand, particularly for its handiness and its ever readiness, entirely ignoring its power cost, even when supplied by the steam gormandizing air-brake pump.

This bugbear of the waste of power in compressed air practice is rapidly disappearing. At the present time, since engineers of the larger type are acquiring the habit of thinking compressed air, compressors in large units are being installed for doing work formerly monopolized by steam, and simply because air is ultimately much the cheaper. In extensive outdoor operations, where there are a number of isolated and widely separated machines, usually steam-driven, it saves steams, saves labour, secures more uninterrupted and reliable service, to install a central air compressing plant and to drive everything with the air.

Say that a dam is to be built in one of our

larger rivers for the development of a great water-power. The most approved and up-to-date practice is, first of all, to place a compressor plant of computed capacity, not neglecting the possible economies in the details of it, and to lay the main pipe lines. In one such case the free air capacity was 5,000 cubic feet per minute. The air is then used as it is needed, not only for the rock drills, if any are enployed, but for practically all the other work, for driving the augers in building cofferdams, for concrete mixers, for traveling pelicans depositing concrete, for derricks and other hoists, for cable conveyors, etc. The air also is used to drive the various tools in the machine shop, the blacksmith shop and the carpenter shop, which are the busy adjuncts of such a plant.

Typical employments of compressed air in the larger way were in the vast excavations required for the Pennsylvania Railroad terminal and the New York Central Railroad stations in New York City. All the power for all the apparatus employed on this work could have been supplied by steam direct, yet steam was only used to drive the air compressors, and the work was then ultimately done by the air.

The drive of the compressors for these large installations will be determined by the individual conditions; sometimes it will be steam, sometimes water power,; and sometimes there will be a direct connected electric motor, the current coming from steam or water, and in the latter case often from a considerable distance.

The air plant for one of the contracts on the Barge Canal is situated close to a main line of railroad, so that it is easy to deliver coal to it, and this is accordingly a steam-driven plant. The work of another contractor only a few miles from this is nearly as far from the railroad, and the compressors there are driven by direct-connected electric motors, the current being conveyed under high voltage some 20 miles from a water power on the upper Hudson.

A repairing shipyard, probably of the largest total capacity on the Atlantic coast, requires a large supply of compressed air for operating the pneumatic tools and other devices, compressors with direct connected electric motors being employed, the pumps for unwatering the drydocks being also so driven. As the power requirements are here quite irregular it was found better to take current from one of the Edison electric stations rather than to instal in the yard a power plant sufficient for maximum demands. This is an old shipyard modernly equipped; if it were to be designed and built entirely new we could suggest that the air lift should be employed for unwatering the drydocks, and then compressed air could do all the work of the yard.

The electric transmission of power which is later transformed into compressed air power for the actual doing of the work, adds much to the electric power totals, and illustrates how beautifully these two rivals work together to the advantage of both.

COAL MINE FATALITIES

Editor Compresed Air Magazine:

On COMPRESSED AIR MAGAZINE, January, 1910, page 5518, the statement is made that 90 per cent. of all deaths in mines are caused by suffocation. In 1906, the last year whose statistics are available, only 15 per cent. of the coal mine deaths were from explosions of all classes, including gas, dust and powder, so probably not 5 per cent. lost their lives through suffocation. The great cause of accident is falling roof, which alone accounted for 50 per cent. of the coal mine fatalities.

R. V. NORRIS, E. M.

Wilkesbarre, Pa.

[The regrettable error of statement referred to was adopted from an eminently respectable source without sufficient scrutiny. In confirmation of Mr. Norris we have the following from the Director of the United States Geological Survey, Washington, D. C.—Ed. C. A. M.]

The statement in your magazine to the effect that 90 per cent. of the deaths in coal mines occur from suffocation must have been meant to apply only to the great disasters which have occurred in the various mines in recent years. The statement made by your correspondent that in the year 1906, fifteen per cent. of the deaths in coal mines resulted from explosions of all classes, and that fifty per cent. of the coal mine fatalities were caused by fall of roof is correct. These statistics were evidently obtained from a bulletin published by the Survey. Mr. Hall states that from his personal observations he believes that ninety per cent. of the lives lost in the Monongah, Dorr,

Naomi, and Yolande disasters, which cost the lives of nearly 700 men, were due to suffocation.

SELF-EXAMINATION FOR YOUNG MINING ENGINEERS

The student of a school of mines should look squarely in the face the facts and circumstances he is likely to or sure to meet with in his mining career after leaving college. We would suggest, for example, that he ask himself such questions as these:

1. Can you cook and set out a good "square" meal with or without the help of some of the men of a mining boarding house in case the cook is ill or leaves suddenly?

2. Can you take charge of and run a boarding house, contract for supplies and lay in store for the winter months and keep accounts yourself.

3. Can you do blacksmithing, sharpen a drill or pick, and do you know the right "color" of tempered steel for certain kinds of rock?

4. Can you do ordinary mine timbering, and do you know when it is well done, or not, by others?

5. Can you swing a hammer, drive drills, blast, etc.?

6. Can you manage men and get along with them and get the proper amount of work out of them?

7. Are you a fair judge of a vein or ore body, and can you form a shrewd idea of its course and how to develop it and how to trace it?

8. Can you give "first aid" in case of an accident, and do you know anything about medicines and practical surgery?

9. Do you know about noxious gases and how to deal with them and how to manage the ventilation of a mine?

10. Can you survey a mine inside and out and assay?

11. Can you keep systematic mining accounts?

12. Are you a judge of the best methods of milling the ores and could you run and manage a mill?

13. Are you well versed in mining and electric machinery? Could you superintend the erection of a hoist, etc.?

14. Can you make mining maps and sections showing the amount of ore stoped out, in view or probable, and where assays have been taken and send in a report to the company that will be intelligible to them?—*Mining Science.*

A MINING ENGINEER ON SKATES

The mining engineer is in Nova Scotia and the skates are native fishes upon which he made a report. He observed that during the lobsters' molting season, the mud flats of Nova Scotia were infested with thousands upon thousands of skate, and that each one dissected contained fragmentary lobster. The government experts who previous to this discovery claimed that the dogfish was the murderer, have now decreed that henceforth the skate shall be converted into fertilizer and glue, which it is hoped will reduce the pest to cash, preserve the lobster and reduce it to more cash.

Up in the country a gasoline engine driving a wood sawing outfit began to run hard and finally wouldn't go at all. A machinist found the cylinder pretty well filled with a hard substance which he decided was burned sugar. The engine had been oiled with a can of maple syrup.

SAFETY IN THE SUBMARINE

It is far from impossible for modern inventors to produce a vessel which may be made to submerge itself at will and to rise again as required, to provide means for its propulsion and manipulation and for performing acts of offensive warfare such as the launching of torpedoes, but the most imperative requirement of all, the guaranteeing of a probability of safety to these who are to operate it under conditions which must inevitably arise in service is the least promising of attainment. Some of the latest developments in this line are talked of in a recent issue of an English publication.

It is pointed out that the crew while in the submarine must be independent of poisonous gases which might be accidentally generated by the leaking in of salt water or otherwise; they must be preserved from drowning while in the boat; means of escape and of rising to the surface must be provided. The devices at present known are air locks for escape, de-

tachable chambers or life boats and self contained dresses. Air locks alone are of little use except in shallow water, but combined either with detachable chambers or with self-contained dresses, they are essential in all methods of escape. When a submarine is holed by accident, the water pouring in will, if the hole be at the top of the boat, gradually replace the whole of the air in the vessel; but if the hole be below the highest point, then the water as it enters will compress the air until the pressure of the latter is equal to that of the water outside. It is obviously necessary, therefore, to provide some device that will catch and contain the air if the vessel be holed high up; hence the provision of air-traps. The accident having taken place, and the boat having sunk to the bottom, air will be compressed either under the deck of the vessel itself or under the air-traps. Beneath the air-traps the men, having put on their special diving-helmets, sit, with their heads in the compressed air, until it is their turn to escape, either through the conning-tower or through the torpedo-hatch, and rise to the surface. In front of the water-proof jacket, attached to the diving-helmet, is a pocket containing a combined purifier and oxygen-generator, which enables the same air, purified and reoxygenated, to be used again and again. The dress, which can be put on in thirty seconds, not only prevents the suffocation of the wearer, but acts as a life-buoy. There are fitted to the air-traps air-supply pipes from the boat's compressed-air cylinders, so that an extra pressure of air may be turned on when necessary.

VACUUM CLEANERS IN INDUSTRIAL PLANTS

The Vacuum cleaner has been developed with much aggressiveness by its various builders, and has now become of recognized utility in industrial as well as residential life. The modern shop and factory are well ordered institutions, and cleanliness is a prime requisite. The vacuum cleaner is a most complete remover of dust and dirt and finer debris of all sorts. The vacuum system of cleaning promises exceptional usefulness in ridding works of those kinds of dust which are injurious to the health of employees. The manufacturers believe that they can be of great service to factories which do wet grinding, by collecting the dried sediment of particles of abrasive and metal. Where an exhaust system is installed, the apparatus is designed to be attached at conveniently spaced stations.. The self-contained unit, with an electric motor attached to the fan, can be employed in any works having electric wiring. The blower and exhaust have a great usefulness, extending over a wide field. The vacuum cleaner is an addition to the scope of effort, which will undoubtedly be adopted quite generally in the next few years.—*Iron Age.*

A TUNNEL TO SAVE A COAL MINE

Several years ago the Mohawk Coal Company opened a drift at Phillipsburg, Pa., and made preparations to mine coal on an extensive scale. The vein tapped was the *B* vein, the most profitable in the bituminous region, but after great expenditure, mostly in preparation, the drift ran into a peculiar dip in the vein, and the water poured in so that the mine was abandoned. It is reported that the mine has lately become the property of the Lehigh Coal Company, and that the mine is now to be worked. Instead of going to work in the old drift the company is preparing to drive a tunnel through the mountain, and at a lower level, so that the water will flow away by gravity. The coal is of superior quality, and runs four feet in thickness without any "fault" streak.

NOTES

The New York office of the Sullivan Machinery Company has been removed from 42 Broadway to 30 Church street, Hudson Terminal.

A South Yorkshire colliery in 1909 drew out of one shaft 4,500 tons in one day, close on 24,000 tons in one week and considerably over 1,000,000 tons in the year, which is thought to be the record in coal mining.

Don't carry powder about your person to soften it, or attempt to thaw it in the flame of a candle, or crimp a cap with your teeth, or "break" a stick in two. Cut it, no matter how dull your knife is, and if you haven't a knife, go and get one.—*Idaho State Mining Report.*

Municipal water works in many cases present excellent opportunities for power development at slight cost. It has been esti-

mated roughly that 50,000 h. p. can be developed on the line of the Los Angeles aqueduct within easy transmission distance of the city, and recently a commission of three specialists has been appointed to make an exhaustive study of the possibilities.

After half a century of development flowing oil wells or "gushers" are still occasionally found in Pennsylvania, a 7,000 barrel well having been brought in quite recently at Shumiston, the first of this size in this field in ten years. The high grade of Eastern oil makes such a strike important.

In a deep Belgian coal mine, at the 3,300 ft. level, cow bells are hung from chains strung across the gangway near the escape shaft. These are so placed that in case of an outburst of gas which might put out the safety lamps the miners would be guided by the bells to the shaft and safety.

A recent washout on the San Pedro, Los Angeles & Salt Lake R. R. took out substantially all the track on the main line between Acorna, Nev., and Rox, about 90 miles. A locating party is already in the field for a new line, the building of which will take six months or a year.

An edict has been issued by Gen. Estrada permitting the free entry of mining machinery and materials for the mining industry of every character. Since the entire east coast of Nicaragua is under Estrada rule and the exempted articles are, in the main, imported along this coast, the order is tantamount to a government ruling.

It has been planned to run a tunnel about 12 miles long at Pachuca, Mexico, starting at a depth of 1,000 feet below the lowest level of any of the mines and to cut them at that depth, or about 3,000 feet below the surface. The main veins to be tapped would be the Santa Gertrude's, the Real del Monte, and the Bar ron.

A valuable by-product is obtained in making chromium by the Thermit process. This by-product has been named corubin and it is claimed to be one of the best abrasive materials obtainable. It is used extensively abroad in the manufacture of high grade emery wheels and emery cloth and for other purposes where a first class abrasive is required.

The 4,725 tons of coal burned by the Lusitania on a record trip across the Atlantic would be fuel enough to keep ten families warm for a generation or more, say a ton a month to each family for 40 years.

At Pierre, South Dakota, on the grounds of the state capitol, there is now an artesian well discharging water at the rate of 5 cubic feet per second and with a pressure at the surface of 165 pounds per square inch.. Mingled with the water is a large volume of natural gas, and it is proposed to use both the water pressure and the gas for light, heat and power purposes. Inquiries are out as to the best means of utilization.

An explosion of a can of asphalt paint occurred recently at a pumping station in Chicago. The can had been placed in a small brick locker room by one of the engineers, and when the explosion occurred the engineer and a coal passer were in the locker. They emerged enveloped in flames. The can showed signs of an internal explosion, the top being partly blown off and the body distorted. Indications are that an explosive fluid had been mixed with the paint to soften it.

The explosion of a tire is the signal for every one to express the most ghoulish glee. No one knows the chauffeur, no one knows the people in the car, there is no personal grudge or apparently any connection between any passerby and the tire in question; but the air is filled with sardonic "Ha's" and every one is overjoyed in obedience to some cruel law which rules some things. One explosion will cheer people as far as the sound carries. It is a deplorable disclosure.—*The Woman Who Saw.*

The German Aerial Navigation Company, of Frankfort-on-Main, has established the first permanent airship lines in Germany. It is the purpose of the company at the start to connect fully 30 cities. It has already received patents for its turn halls for motor balloons, and it will erect the first halls in Berlin, Munich and Strassburg in Alsace. The extensive plans of the company have

aroused the liveliest interest on all sides, and their execution appears to be financially assured.

Fertitlizer formulas comprise three figures, as 4-8-10, and these always refer in the same order to nitrogen, available phosphoric acid and potash, respectively. These figures multiplied by 20 will give the number of pounds of each kind of plant food contained in a ton of the mixture. Thus, in a 4-8-10 fertilizer there are $4 \times 20 = 80$ pounds of nitrogen, $8 \times 20 = 160$ pounds of phosphoric acid, and $10 \times 20 = 200$ pounds of potash.

The Shoshone dam, the highest in the world, built by the reclamation service, is completed. It is in the canon of the Shoshone river in northern Wyoming, and is 328 ft. high. The walls of the canon are nearly vertical and rise nearly 2,000 ft. above the stream. At its base the thickness of the dam is 108 ft., and its length, the width of the gorge, is 70 ft., and at the top its length is 175 ft. The dam creates an enormous reservoir with a surface area of 10 miles, and with a storage depth of 70 ft. its capacity is 148,500,000,000 gallons.

According to recent consular reports, the European governments have available for service 32 dirigibles and 56 aeroplanes, as follows: Germany, 14 dirigibles of six different models, Gross, Zeppelin, Parseval, Schutte, Siemens—Schuckert and the Rhine-Westphalian air ship, and five aeroplanes; France, seven dirigibles and 29 aeroplanes; Italy, three dirigibles and seven aeroplanes; Russia, three dirigibles and seven aeroplanes; Austria, two dirigibles and four aeroplanes; England, two dirigibles and two aeroplanes; Spain, one dirigible and three aeroplanes.

The advantage of mounting a machine drill on a cross-bar instead of on a vertical post, is that, in driving, the machine can be set up and started running while the muckers are taking care of the rock shot down with the last round of holes. If a post were used, it would be necessary to muck out at the foot of the post, clear down to the floor, before the machine could be securely placed in position. When drilling on a bar, the back and breast holes are put in first, and by the time the machine has to be swung under the bar for the lifters, the rock underfoot has all been removed.

The French call the power derived from waterfalls *houille blanche*—"white coal"—and a singular combination of the power derived from white and from black has recently been effected at Etupes, in Eastern France. At that point electric conductors coming from the coal mines of Ronchamp, 18 miles north of Etupes, meet similar conductors coming from the waterfalls of Le Refrain, 24 miles south of Etupes. The current derived from the mines is of 30,000 volts and that from the waterfalls of from 30,000 to 50,000 volts. At Etupes the power is combined in a large plant, provided with transformers and distributors, and sent out to run shops, light lamps, and so forth.

Under the direction of Mr. Edward O'Toole, General Superintendent, the U. S. Coal and Coke Company, at Gary, W. Va., is laying down a 24-inch experimental pipe for testing the practicability and the economy of pneumatic transportation as already employed for grain, sawdust, ashes, etc. The deterring feature heretofore has been the unwarranted power consumption; it is claimed now, however, that by using a number of vacuum chambers the power required may be greatly reduced, and that by the addition of successive vacuum chambers the distances through which coal can be transported may be indefinitely increased. It is expected that reliable and valuable practical data will be furnished by this installation.

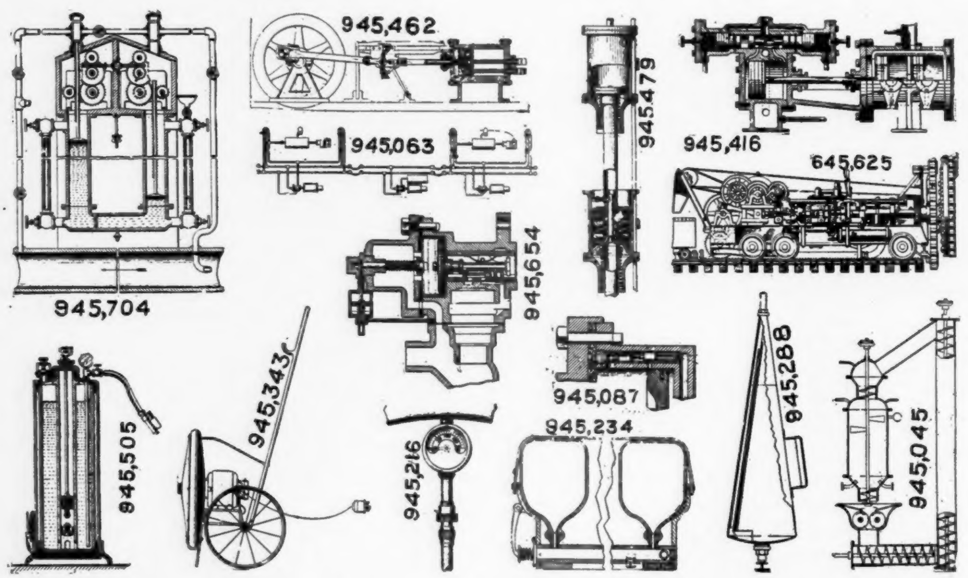
On December 14, 1909, the first shipment on the American continent of calcium cyanamid or lime nitrogen, was made. It comprised 300 bags (26 tons) sent from the plant at Niagara Falls, Canadian side, to the American Cyanamid Company, Baltimore. This company operates a plant at Niagara Falls, using 8,000 horse power and obtaining the nitrogen of its product directly from the atmosphere. The installation is said to already represent an investment of $600,000. It is being built in units of 10,000 tons per annum capacity, but one as yet being in operation. The company operates a plant at Baltimore for reducing and refining its product and putting it into marketable shape to meet the requirements of the various fertilizer manufacturers.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JANUARY 4.

945,048. APPARATUS FOR MAKING OXYGEN. Charles Ridley, London, England.
945,063. AUTOMATIC AIR-BRAKE. Walter V. Turner, Edgewood, Pa.
945,087. FLUID - PRESSURE RAILWAY-BRAKE. Charles G. Frey, Youngwood, Pa.
945,209. ROCK-DRILL. Addison Avery, Chicago, Ill.
945,216. AIR-PRESSURE INDICATOR. Henry W. Brown and Garrett H. Brown, Syracuse, N. Y.
945,234. PNEUMATIC MATTRESS. Nehemiah C. Hinsdale, Marion, Ind.
945,288. PRESSURE-COMPENSATING DEVICE FOR THE AIR INCLOSED IN FIRE-EXTINGUISHING APPARATUS. Karl Schmidt, Neuruppin, Germany.



Pneumatic Patents January 4.

945,343. VACUUM CLEANING APPARATUS. Charles R. Pollard, Hartford, Conn.
945,416. AIR-SWITCH. Charles F. Preslar, Cincinnati, Ohio.
945,462. FLUID-PRESSURE ENGINE. Jacob P. Klein and Adolf Friederichs, San Bernardino, Cal.
945,479. MACHINE FOR FORMING CUP-LEATHERS. Wayland F. Smith, San Bernardino, Cal.
945,505. APPARATUS FOR REMOVING PAINT AND VARNISH. Charles J. Fess, Newark, N. J.

5. An apparatus for heating and spraying varnish remover comprising an inclosed cylinder, an air-pump associated therewith, a removable receptacle adapted to surround the cylinder and to form an air-space about the sides of the cylinder, a rheostat in the receptacle, a high resistance element, and a manually operated switch arranged to connect the rheostat directly across the mains from a suitable source of electrical supply, or to connect the rheostat and a high resistance element in series across said mains.

945,623. TUNNELING-MACHINE. Louis F. Sleade, Denver, Colo.
945,654. AUTOMATIC TRIPLE VALVE FOR AIR-BRAKES. Albert V. Wester, Gallitzin, Pa.
945,704. GAGE FOR DETERMINING THE VELOCITY OF FLUIDS. Francis H. Crawford and Michael B. Carmody, Columbus, Ohio.

JANUARY 11.

945,758. AIR-BRAKE APPARATUS. Nathan H. Davis, Philadelphia, Pa.
945,815. PNEUMATIC TOOL. Herman Schweim, Detroit, Mich.
945,884. VALVE FOR PNEUMATICALLY-CONTROLLED MUSICAL INSTRUMENTS. Peter Welin, Newcastle, Ind.
945,988. AIR-COMPRESSOR. Charles G. Simonds, Schenectady, N. Y.
945,998. APPARATUS FOR SUBMARINE SIGNALING. Edward C. Wood, Somerville, and Harry G. Marden, Braintree, Mass.

1. A means for operating the striking means of a submarine signaling apparatus having a sounder and a striking means comprising a cylinder, a differential piston moving therein and connected with said striking means and a compressed air reservoir permanently connected with the smaller side of said piston, and intermittently connected with the larger side thereof, in combination with a casing containing said cylinder and said reservoir, as described.

946,025. FLEXIBLE PIPE-JOINT. Albert G. Elvin, Franklin, Pa.
946,069. APPARATUS FOR DRYING AIR. Irving H. Reynolds and Fred E. Norton, Youngstown, Ohio.
946,101. INFLATING-PUMP FOR MOTOR-VEHICLE TIRES. Max Bohne, Berlin, Germany.
946,307. TANK FOR ADMINISTERING OXYGEN. George von Ach, Newark, N. J.
946,368. PNEUMATIC HAMMER. Charles L. Jones, Urbana, Ill.
946,420. ROCK-DRILL. Ralph F. Yourtee and William E. Maull, St. Louis, Mo.

JANUARY 18.

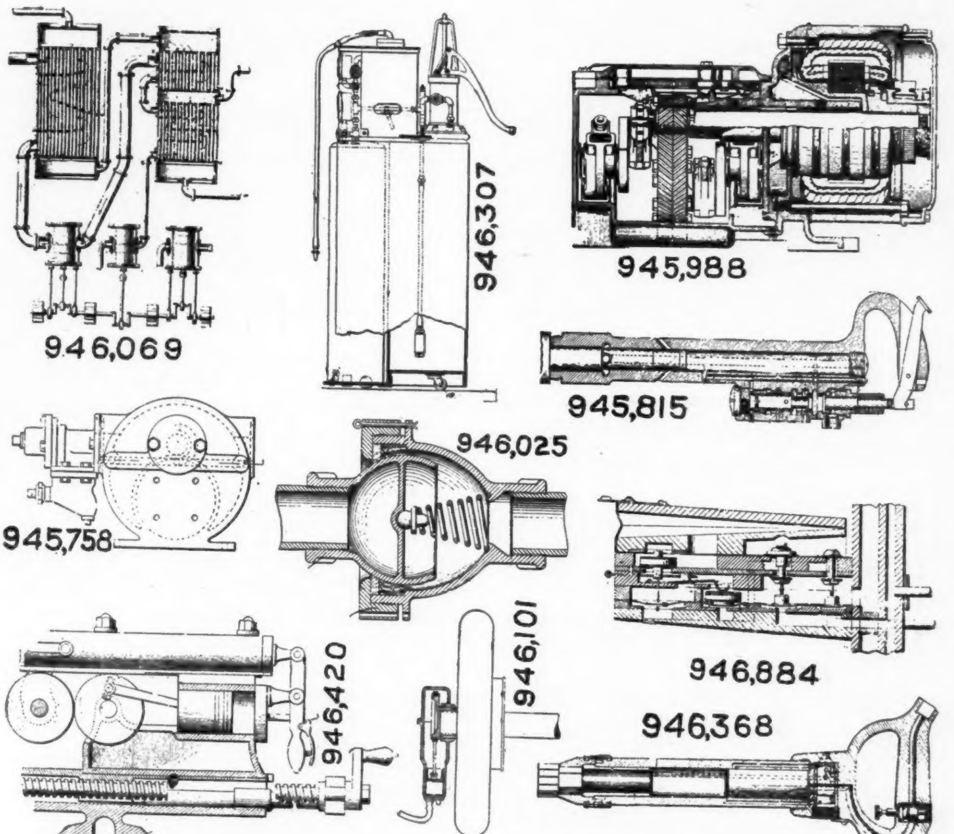
946,535. SEPARATOR FOR PNEUMATIC CLEANERS. FRANK B. CRAVER, Rochester, N. Y.

946,678. AIR-SHIP AND AEROPLANE. EDWIN J. LESTER and WILLIAM G. BEST, Clapham, England.

946,683. HYDRAULIC AIR - COMPRESSOR. JOHN W. NEAL, Kealia, Hawaii.

946,684. BACK-PRESSURE VALVE. CHARLES C. NEIGHBORS, San Antonio, Tex.

1. In a humidifier for discharging mingled water and air under pressure, the combination of a nozzle having a plurality of tubular passages extending longitudinally through said nozzle and parallel with each other, each of which passages has a closed bottom and is provided with a radially directed discharging orifice; a deflecting device mounted in the upper end of said nozzle centrally between said tubular passages; and an annular flange mounted on the nozzle at or adjacent to all said discharging orifices and approximately in the plane thereof, and provided



PNEUMATIC PATENTS JANUARY 11.

946,719. AIR-PUMP. FRED S. CARVER, Brooklyn, N. Y.

946,801. VACUUM-CLEANER. ROBERT B. HUTCHISON, Wilkinsburg, Pa.

946,832. VACUUM CLEANING DEVICE. JOHN N. WHITEHOUSE, New York, N. Y.

946,843. DRYING APPARATUS. DANIEL HURLEY, Providence, R. I., and JOHN E. O'SHEA, New York, N. Y.

946,889. HEATING, COOLING, AND VENTILATING SYSTEM. JULES C. VEIL, New York, N. Y.

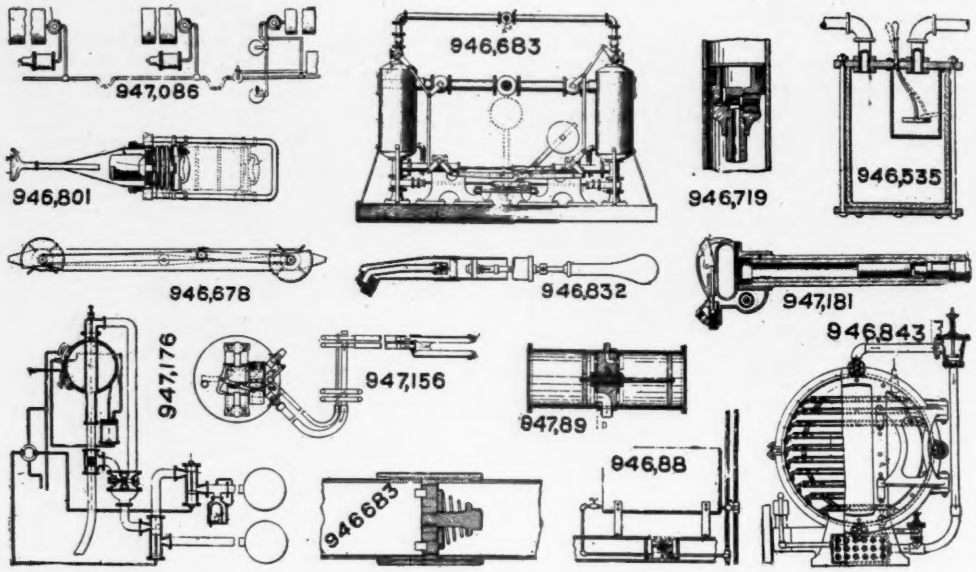
947,040. HUMIDIFIER. JAMES KELLY, Providence, R. I.

with a concaved upper surface; all arranged so that the current of said mingled water and air is divided and separated by the deflecting device and directed thereby through the tubular passages in separate currents, which are discharged therefrom upon the concaved surface of the annular flange.

947,086. FLUID - PRESSURE AIR - BRAKE MEANS. GEORGE T. ROWTON, Jackson, Miss.

947,156. PNEUMATIC MILKING APPARATUS. ALEXANDER GILLIES, Heidelberg, Victoria, Australia.

947,176. PNEUMATIC APPARATUS. EMMANUEL L. J. GISSOT, Vanves, France.



PNEUMATIC PATENTS JANUARY 18

947,181. FLUID - PRESSURE - OPERATED TOOL. CHARLES H. JOHNSON, Springfield, Ill.

947,189. VACUUM AND FLUSHING APPARATUS. DAVID RODERICK, San Diego, Cal.

JANUARY 25.

947,300. HUMIDIFIER. JOHN W. FRIES, Winston Salem, N. C.

947,301. HUMIDIFIER. JOHN W. FRIES, Winston Salem, N. C.

947,333. VENTILATION AND AERATION OF SEWAGE IN SEWAGE PLANTS. FRANK HAMILTON, Jamaica, N. Y.

947,385. DEVICE FOR PREVENTING WRECKS UPON RAILWAYS. JOHN G. HENZEL, Chicago, Ill.

947,513. TIRE-PUMP. WILLIAM S. STAPLEY, Bridgeport, Conn.

947,533. PUMP DRIVEN BY MEANS OF COMPRESSED OR RAREFIED GAS. OLOF RODHE, Stocksund, Sweden.

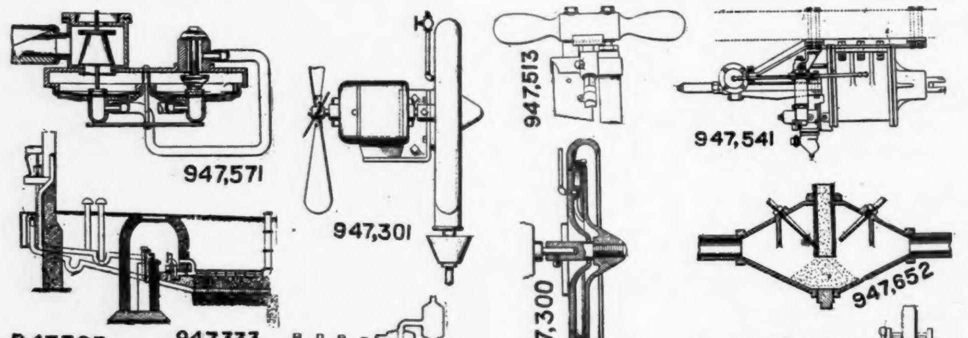
947,541. AIR-BRAKE-CYLINDER ATTACHMENT. CHRISTOPHER P. CASS, Maplewood, and HENRY A. WAHLERT, St. Louis, Mo.

947,652. TRACK-SANDING APPLIANCE. FRED G. SCHWARTZ, Colorado City, Colo.

947,688. PNEUMATICALLY-OPERATED TYPE-WRITING MACHINE. MAX SOBLIK, Dusseldorf, Germany.

947,717. APPARATUS FOR THE PRODUCTION OF CARBURETED AIR. MORTIMER F. MIEVILLE, Chichester, England.

13,078. ANIMAL-CLEANING APPARATUS. CONRAD HAMMER, Buffalo, N. Y. (Reissue).



PNEUMATIC PATENTS JANUARY 25.

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- Galigher Machinery Co.
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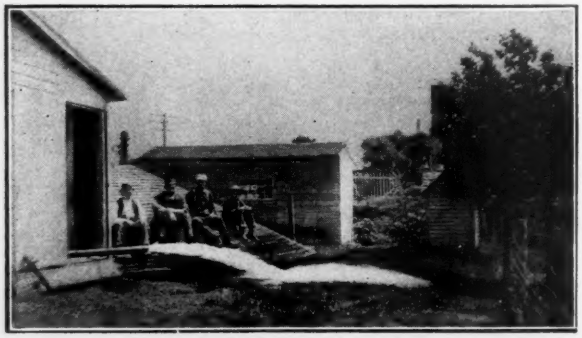
- Ingersoll-Rand Co.
- McKiernan Drill Co.
- Porter Co., H. K.
- Stearns-Roger Mfg. Co.
- Sullivan Machinery Co.
- Westinghouse Traction Brake Co.



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Stearns-Roger Mfg. Co.

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Sullivan Machinery Co.

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Cleveland Pneumatic Tool Co.
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Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

Pumping Systems, Pneumatic.
Bury Compressor Co.
Curtis & Co. Mfg. Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
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Pumps, Air.
Cameron Steam Pump Works, A. S.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Westinghouse Traction Brake Co.

Pumps, Pneumatic Displacement.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Westinghouse Air Brake Co.

Pumps, Steam.
Cameron Steam Pump Works, A. S.
Galigher Machinery Co.
Stearns-Roger Mfg. Co.
Westinghouse Air Brake Co.

Quarrying Machinery.
Bury Compressor Co.
Cameron Steam Pump Works, A. S.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

Reducing Valves.
Mason Regulator Co.

Rock Drills, Air and Steam.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

Rock Drills, Electric-Air.
Galigher Machinery Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Sand Blast Machinery.
American Diamond Sand Blast Co.
Curtis & Co. Mfg. Co.
Druckleib, C.
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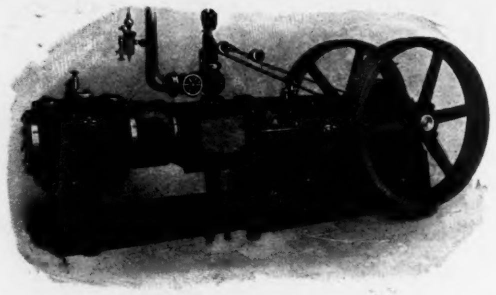

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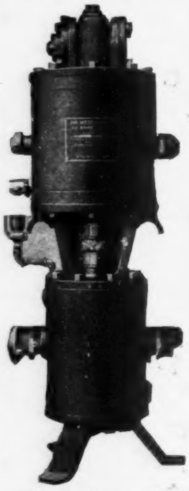

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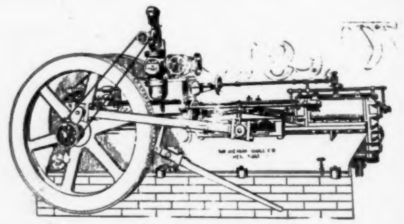

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